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CONTENTS

Space Policy, Administration

Cosmonauts Plan 25 April Space Walk

LD2504174191 Moscow Central Television Vostok Program and Orbita Networks in Russian 1530 GMT 25 Apr 91

[From the "Vremya" newscast]

[Text] The crew of the Mir space station, Viktor Afanasyev and Musa Manarov, will carry out a space walk at 2315 today. Their task is to try to repair a docking antenna attached to the Mir complex. The damage to this device almost caused the Progress-M freighter to crash into the station on 23 March this year. The antenna was broken when one of the cosmonauts touched it with his boot during a previous space walk.

TASS Reports Details of 25 April EVA

LD2604083491 Moscow TASS in English 0817 GMT 26 Apr 91

[By TASS correspondent from the Mission Control Center]

[Text] Moscow April 26 TASS—The crew of the Soviet orbital complex Mir have carried out a regular phase of extravehicular activities.

Viktor Afanasyev and Musa Manarov went out into open space through the hatch of the air-lock compartment of the Kvant-2 module at 23:29, Moscow time, on April 25.

When outside the orbital complex the cosmonauts installed an experimental assembly of a thermo-mechanical joint. Subsequently similar elements will be used to assemble large-size constructions in orbit.

The mission commander attached a television camera on the adjustable platform of the Kvant-2 module. The TV camera is used in geophysical research. Earlier the camera had been dismantled by the crew to replace [a] lens.

The principal purpose of the space walk was to gauge the state of the antenna of the radiotechnical docking system, mounted on the astrophysical module Kvant. The malfunction of the antenna was reported to have been the cause of the unconventional situation during the docking of the Progess M-7 cargo spacecraft.

During extravehicular activities the flight engineer moved to the Kvant module. He inspected the outer elements of the antenna and reported their condition to experts at the Mission Control Center.

Prior to returning to the station, the crew dismantled samples of structural materials that had been exposed to open space for a long time and removed the experimental assembly of the thermo-mechanical joint that had been put on the outer surface of the orbital complex at the beginning of the space walk.

Following extravehicular activities which continued for three hours and 34 minutes, Afanasyev and Manarov are feeling well.

Cosmonauts Preparing To Undock 'Progress M-7'

LD0505131991 Moscow TASS in English 1304 GMT 5 May 91

[Text] Moscow May 5 TASS—TASS correspondent reports from the Flight Control Center:

Viktor Afanasyev and Musa Manarov are beginning their sixth month on the "Mir" scientific research space complex.

The cosmonauts have spent the past two days on final jobs with the automatic "Progress M-7" vehicle. The equipment it delivered to them had to be installed in the station and its modules. The ballistic capsule, included in the cargo vehicle, had to be prepared for return to the earth. The "Progress M-7 is expected to leave the orbital complex on May 6.

The crew has also carried out several experiments with the use of "Buket", "Sprut-5" and "Lyulin" instruments in order to measure cosmic radiation and check the radiation situation in the near-earth space.

Afanasyev and Manarov feel well.

Soviet-British Crews Leave for Launch Site

LD0405114691 Moscow TASS International Service in Russian 1050 GMT 4 Apr 91

[By TASS correspondent Rena Kuznetsova]

[Text] Moscow, 4 May (TASS)—The two Soviet-British Crews, the main one and the back-up, left today for the Baykonur launch site for prelaunch preparations for the joint space flight, TASS was told at the Cosmonaut Training Center.

The first crew comprises Soviet cosmonauts Anatoliy Artsebarksiy and Sergey Krikalev and the Englishwoman, Helen Sharman; the second crew comprises Soviet cosmonauts Aleksandr Volkov and Aleksandr Kaleriy and Timothy Mace, who is British. The state commission will decide on the eve of the launch, which is scheduled for 18 May, who will fly into space. To date, however, Helen Sharman has the greater chance, since she is in the main crew.

Sergey Krikalev and Aleksandr Volkov are experienced cosmonauts. The former spent 153 days in space during his flight, and the latter has already worked in space twice. Anatoliy Artsebarskiy and Aleksandr Kaleriy are new recruits to space.

The two crews are equally well prepared for work in the Mir orbital complex, stated Aleksey Leonov, deputy chief of the Cosmonaut Training Center, in a conversation with TASS. Working there now are the crew of the eighth main expedition, Viktor Afanasyev and Musa

Manarov, who went up on 2 December last year with Japanese journalist Toyohiro Akiyama. Now they are due to receive the international crew. Then they will return to earth with the British research cosmonaut. The international flight will last eight days.

'Progress M-7' Spacecraft Undocked From Mir

LD0705174291 Moscow TASS in English 1406 GMT 7 May 91

[By TASS correspondent at Mission Control Center]

[Text] Moscow May 7 TASS—The unmanned Progress M-7 space freighter was jettisoned from the Soviet orbiting Mir platform at 02:00 today and is expected to burn up in the atmosphere tonight, while its heat-protected descent capsule will land in a preset area.

All planned operations involving the cargo spacecraft were performed in full—unloading delivered supplies, replenishing the station's stocks of fuel and oxidiser, and using the spacecraft's motors to correct Mir's orbit.

Cosmonauts Viktor Afanasyev and Musa Manarov, meanwhile, continue to work aboard Mir. Today they are busy setting up scientific equipment for scheduled experiments and undergoing regular medical checks.

Destructive Reentry of 'Progress M-7'

LD0805102691 Moscow TASS International Service in Russian 0922 GMT 8 May 91

[By TASS correspondent at Flight Control Center]

[Text] Moscow, 8 May (TASS)— The 'Progress M-7' automatic freighter, which was undocked from the 'Mir' scientific research complex on 7 May, has ended its flight.

A few hours after the separation, the cargo spacecraft was oriented in space by command from the Control Center, and at 1924 Moscow time its engine was turned on. As a result of braking, the 'Progress M-7' craft went into a descent trajectory, entered the dense layers of the earth's atmosphere, and burned up.

'Soyuz TM-12' Launched With British Woman Cosmonaut

LD1805125991 Moscow TASS in English 1254 GMT 18 May 91

[By TASS correspondent Rena Kuznetsova]

[Text] Moscow May 18 TASS—The Soviet Soyuz TM-12 spaceship has just been fired off from the Baykonur Cosmodrome. The spaceship carries a Soviet-British crew consisting of Soviet Cosmonauts Anatoliy Artsebarskiy, Sergey Krikalev and British woman cosmonaut Helen Sharman.

Viktor Afanasyev and Musa Manarov, who have worked for six months in space, are waiting for them aboard the Mir space station where the mixed team will work for six days.

Crew Describes Scheduled Activities

LD1705203991 Moscow TASS in English 1840 GMT 17 May 91

[Text] Baykonur Space Center May 17 TASS—The State Commission on Friday named the Soviet-British crew, which will blast off on Saturday at 15:52 Moscow time [1252 GMT] in a Soyuz TM-12 craft from the Baykonur Space Center in Central Asia.

The crew consists of Commander Lieutenant-Colonel Anatoliy Artsebarskiy (call sign "Ozon"), engineer Sergey Krikalev and British researcher Helen Sharman.

Colonel Aleksandr Volkov, Aleksandr Kaleriy and Timothy Mace are in the stand-by crew.

At a news conference in Baykonur, the cosmonauts described the program to be carried out aboard the Soviet orbiting Mir space station during four and a half months.

The Soviet-British flight is its first stage. Sharman will spend six days on board the station, conducting scientific experiments.

Artsebarskiy and Krikalev will take over the Mir space station from Musa Manarov and Viktor Afanasyev, who will return to earth together with Sharman.

The new crew will carry out an extensive scientific program, which includes space exploration and scientific experiments and repair and assembly work on the station's outer surface to move solar batteries to a new place.

Their "wings" prevent the space shuttle Buran from docking with the station, which is a major part of the Buran's scheduled flight.

Initial Rendezvous Maneuver Completed

LD1905120291 Moscow TASS in English 1143 GMT 19 May 91

[By unidentified TASS special correspondent from the Mission Control Center]

[Text] Moscow May 19 TASS—The Soyuz TM-12 spaceship continues its flight with the Anglo-Soviet space crew on board.

Over the past 24 hours Anatoliy Artsebarskiy, Sergey Krikalev and Helen Sharman performed routine operations to check the serviceability of the on-board systems and the air-tightness of the spaceship's compartments. They carried out a two-pulse initial rendezvous maneuver towards the orbital complex Mir.

The parameters of the spaceship's orbit following the maneuver are as follows:

—maximum distance from the Earth's surface—333 kilometers,

—minimum distance from the Earth's surface—264 km,

—orbital period—90.2 minutes,

—inclination—51.6 degrees.

Meanwhile Soviet cosmonauts Viktor Afanasyev and Musa Manarov on board the Mir are having a day off today, without research or experiments. They are having a rest, doing physical exercises and preparing to host the visiting crew.

An estimated time of the two spacecraft's docking is 1725 on Monday, May 20.

'Soyuz TM-12' Docks With Mir Complex

LD2005233191 Moscow TASS in English 1430 GMT 20 May 91

[By TASS Correspondent Rena Kuznetsova]

[Text] Moscow May 20 TASS—The spaceship Soyuz TM-12 has just docked with the Soviet orbital complex Mir.

The spaceship is manned by a Soviet-British crew—Soviet cosmonauts Anatoliy Artsebarskiy and Sergey Krikalev, and British research Cosmonaut Helen Sharman—who were launched on May 18.

The eighth main expedition, Viktor Afanasyev and Musa Manarov, have been aboard the Mir orbital complex for the sixth month now.

Gorbachev Speaks With Mir Cosmonauts

LD2005210191 Moscow All-Union Radio Mayak Network in Russian 1830 GMT 20 May 91

[Conversation between USSR President Mikhail Sergeyevich Gorbachev; USSR cosmonauts Viktor Mikhaylovich Afanasyev, Musakhi Romanovich Manarov, Anatoliy Pavlovich Artsebarskiy, Sergey Konstantinovich Krikalev; and UK cosmonaut-researcher" Helen Sharman on 20 May; Gorbachev is in Moscow, speaking to the cosmonauts as they orbit Earth on the Mir space station; cosmonauts are not identified as they speak—recorded]

[Text] [Cosmonaut] Mikhail Sergeyevich, good evening.

[Gorbachev] Good evening.

[Cosmonaut] The crew of the Mir orbital complex welcomes you.

[Gorbachev] I am sincerely glad for this meeting and this great event. I would like to express joy and admiration at what you are doing. This is great work, and it is natural that it is within the competence of courageous people and modern and educated people. I would like to express admiration that today you, the two crews, acted together very skillfully in difficult conditions and showed endurance, and you were not nervous. I must say that we know here that Helen Sharman also acted well, so she fitted into the team well, as I see it. In sum, I congratulate you.

[All cosmonauts] Thank you.

[Gorbachev] What are you doing now?

[Cosmonaut] We are getting ready for supper.

[Gorbachev] Ooooh! [laughs] If we had linked up a little later, we could probably have joined you, so to speak.

[Cosmonaut] We can wait, Mikhail Sergeyevich.

[Gorbachev] How do you feel, Viktor Mikhailovich and Musa Khiromanovich?

[Cosmonaut] Fine. The crew who have arrived are also fine.

[Cosmonaut] Even better than fine. We are glad the replacements have come.

[Gorbachev, laughing] Well, I congratulate you. I know that you have a special climate there. There must be a basis of friendship, complete compatibility, and devotion to each other and this great work. It cannot be otherwise. How about Helen? Can I speak with her?

[Sharman] Good evening. I can say that the two days I was in the ship with Anatoliy and Sergey, they worked very well. The work was very difficult, especially at the beginning, when weightlessness begins to work. They worked very well, and they helped me very much.

[Gorbachev] Well, I am glad to hear that your voice is good, strong, and happy.

[Sharman, laughing] Very happy. [Gorbachev laughs] We have two other friends here: Musa and Viktor. They are very happy and pleasant.

[Gorbachev] I congratulate you on this meeting, and this event in your life, and this great event for our two peoples.

[Sharman] Thank you. Of course, a great deal of work has already been done because we have been preparing for the flight. It is not only starting now. Nevertheless, I also hope that this will help the friendship between our countries.

[Gorbachev] Very good. In recent years, we have, indeed, continually been getting closer together, expanding our cooperation. Your flight with our cosmonauts is a symbol of this cooperation. I congratulate both you and our cosmonauts, and in your person, our peoples as well.

[Sharman] Thank you.

[Gorbachev] Helen, the comrades here, my colleagues, have told me that during the flight, during the initial stage, you displayed a great deal of self-control and will, and this was a matter of great joy for them. They say that you had to show a great deal of skill, knowledge, and self-control regarding the docking, too, and that, in this case, too, Helen worked along harmoniously. You're a fine girl, as we say, and I congratulate you on that!

[Sharman] Thank you.

[Gorbachev] Viktor Mikhailovich, Musa Khiromanovich, Anatoliy Pavlovich, Sergey Konstantinovich, and, finally, our guest—well, not only a guest but a full member of the crew—I wish you a successful flight, successful fulfillment of the program. To those who will remain in orbit, I wish success and good fortune in your work and well-being. To those who will return, I also hope that everything goes well. We will be waiting for you!

[Manarov] Many thanks. Hearty wishes for good health and all the very best!

[Gorbachev] Will you be having a first-rate dinner?

[Manarov] Why, of course, we certainly will.

[Gorbachev] Goodbye! All the best!

[All cosmonauts] Goodbye! All the best!

Gorbachev Sees Flight as Boost for UK-USSR Cooperation

LD2005180191 Moscow TASS in English 1731 GMT 20 May 91

[Text] Moscow May 20 TASS—It was announced here today that the Soyuz TM-12 spaceship docked to the Mir space station today, May 20, at 17:31.

The Soviet-British crew consisting of Viktor Afanasyev, Musa Manarov, Anatoliy Artsebarskiy, Sergey Krikalev and Helen Sharman began to implement their work program, says a telegram sent by commander of the mixed crew Viktor Afanasyev to President Mikhail Gorbachev.

Their work program includes scientific, technical and medico-biological experiments.

In a reply telegram, the president cordially congratulated the Soviet-British crew on the start of the joint work aboard the Mir complex.

"Your flight graphically shows a chance to raise friendship and cooperation between our countries to higher levels," Gorbachev's telegram says. The president wished the cosmonauts the successful implementation of the flight program and happy return to Earth.

Afanasyev thanked the president for warm greetings and good wishes.

Object Seen Floating Near Mir Complex

LD2105203291 Moscow Central Television First Program Network in Russian 1800 GMT 21 May 91

[From the "Vremya" newscast]

[Excerpts] The flight of the Soviet-British crew onboard the Mir station is continuing. There are already primary results from the joint work. Not all of them, however, can be unequivocally interpreted. Our correspondent reports:

[Begin recording] [Correspondent P. Orlov] [passage omitted] Yesterday evening, during the late communication session, a strange object was filmed. You can see it, there, at the very center of the screen. [Video shows the Mir station in space and a phosphorescent object hovering around it]

If it is a UFO, so be it. But Musa Manarov, who was filming the craft during docking with the station, has doubts, saying that he saw how that thing was coming off the craft. Of course, there is nothing cheerful in the fact that an object of quite a considerable size is flying around the station, even if it is not a part of the Soyuz cargo craft.

[Orlov] Let us recall that Helen Sharman is the first woman on board the Mir station, something to make seamen envious. Joking aside, it is still not clear what it is that is accompanying the station. [end recording]

Well, we will wait for further reports. The fact is quite interesting indeed, and perhaps, fairly alarming.

Progress of Soviet-British Space Mission Reported

LD2105192191 Moscow TASS in English 1627 GMT 21 May 91

[By TASS correspondent Rena Kuznetsova]

[Text] Moscow May 21 TASS—Helen Sharman, the British researcher on board the Soviet space station Mir has been granted the best living quarters aboard the station—a room with a view of the earth—by her male colleagues—members of the Soviet-British space crew.

Cosmonauts Viktor Afanasyev, Musa Manarov, Anatoliy Artsebarskiy, Sergey Krikalev and Helen Sharman have been working on board the station for two days already.

A spokesman for the Mission Control Center told TASS that the cosmonauts devoted their efforts on Tuesday to technological and biotechnological experiments.

The Soviet-British crew's mission program includes space biology research. A set of devices and biological samples have been delivered on board to test possible technologies for creating promising life-support systems using well-developed plants.

Helen Sharman is busy doing a series of experiments to identify the impact of raw space on the properties of construction materials.

The Vita installation is used to carry on the complex experiment which began on May 20 to study the dynamics and peculiarities of the growth of complex cell cultures capable of producing biologically active substances.

All five cosmonauts are feeling fine. Specialists in the mission control centre noted that Helen Sharman has well adjusted to zero-gravity.

The mission is due to end on May 26. Back on earth, Helen will mark her 28th birth anniversary on May 30. Her age is now known to all people on earth so there is no point in keeping mum about the occasion. After all, her age is an asset which there is no need to conceal.

Crew Conducts Experiments

LD2205122591 Moscow TASS in English 1200 GMT 22 May 91

[By TASS correspondent at Mission Control Center]

[Text] Moscow May 22 TASS—The Soviet-British space team aboard the Mir space station today were busy doing medical, biological, technological and biotechnological experiments.

Briton Helen Sharman used an instrument called Reflotron to conduct biochemical blood analyses in order to increase information about the peculiarities of a human organism's adaptation to space.

She will also perform an experiment to evaluate an equipment operator's efficiency in weightlessness.

The team, who also include Soviet cosmonauts Anatoliy Artsebarskiy and Sergey Krikalev, started experiments in the Svetoblok, Vazon and Magnitogravistat greenhouses to study possibilities to grow higher plants in zero gravity.

In addition to other work, Artsebarskiy and Krikalev are getting briefings from the station's resident crew of Viktor Afanasyev and Musa Manarov, whom they are going to replace, on the whereabouts of various equipment and the peculiarities of operating on-board systems.

Sharman Continues Experiment Program

LD2405175491 Moscow TASS in English 1634 GMT 24 May 91

[By TASS correspondent Rena Kuznetsova]

[Text] Moscow May 24 TASS—Soviet cosmonauts Viktor Afanasyev, Musa Manarov, Anatoliy Artsebarsky, Sergey Krikalev and British researcher Helen Sharman began their working day on Friday at 8:00 Moscow time.

Sharman was late for breakfast because she was busy conducting the medical experiment "Reflotron". She made a biochemical analysis of her own blood and that of the Mir station's residents crew of Musa Manarov and Viktor Afanasyev.

During the day, Sharman carried out the technological experiment "Elektrotopograf" to study the degradation of dielectrical materials in raw space and test them, using an electrotopographic control method.

She especially likes the experiment "Vazon" aiming to study how little orchids and a dwarf magnolia vine help improve the psychological atmosphere aboard the station.

The cosmonauts also continue other experiments envisaged by the joint Soviet-British flight's program.

Afanasyev and Manarov, who will be relieved by Artsebarskiy and Krikalev, have begun preparing the Soyuz TM-11 spaceship for the return flight to earth. The former two and the British researcher are expected to land on Sunday, May 26.

Afanasyev, Manarov, Sharman Return to Earth in 'Soyuz TM-11'

LD2605121891 Moscow TASS in English 1201 GMT 26 May 91

[Text] Moscow May 26 TASS—Soviet cosmonauts Viktor Afanasyev and Musa Manarov and British cosmonaut-researcher Helen Sharman returned to Earth at 13.05 Moscow time today after completing the flight program on board the orbital station Mir.

The Soyuz TM-11 spaceship's descent vehicle landed in a designated area in Kazakhstan, 68 kilometers southeast of the city of Dzhezkazgan. After landing, the cosmonauts are feeling well.

Work in space on board the orbital complex Mir is being carried on by the crew of the ninth long-duration expedition—Anatoliy Artsebarskiy and Sergey Krikalev.

During the eighth, 175-day, expedition, the cosmonauts continued work in the main fields of the research program on board the complex Mir: astrophysics, technology, geophysics, biology and biotechnology.

The crew made four space walks. They installed and tested a telescopic jib intended for assembly operations on the outer surface of the orbital complex and carried out the planned repair and rehabilitation work.

A considerable part of the country's territory and individual areas of the world ocean were photographed for further study of the Earth's natural resources. Throughout the flight cosmonauts regularly measured fluxes of particles of cosmic origin in the near-Earth space.

The cosmonauts grew monocrystals of semiconductor materials with improved characteristics and carried out

experiments to further study the effectiveness of cultivating complex cellular cultures in zero gravity for their subsequent applications in medicine and pharmacology. They also carried out a cycle of experiments to gauge possibilities for creating (credited) life-support systems with the use of higher plants.

An example of developing Soviet-British cooperation in space exploration has been provided by Helen Sharman and the Soviet crews. During the flight Ms. Sharman carried out a large amount of medico-biological research, and performed technological and biological experiments.

The results of work during the eighth expedition on board the permanently functioning orbital complex Mir will be utilized in various branches of science and the economy.

Cosmonauts at Post-Flight News Conference

LD2705174191 Moscow TASS in English 1455 GMT 27 May 91

[By TASS correspondent Rena Kuznetsova]

[Text] Moscow May 27 TASS—Despite 175 days in space Viktor Afanasyev and Musa Manarov, the crew of the eighth main expedition aboard the Mir space station, are in good shape and doctors okayed their participation in a brief news conference in Star City outside Moscow.

The two cosmonauts responded to questions from Soviet and foreign journalists. The first British cosmonaut Helen Sharman, who also [words indistinct] news conference, looked fine both during her space mission and back on earth.

Deputy chief of the Cosmonaut Training Center General Alexey Leonov opened the news conference, as he had done before Anatoliy Artsebarskiy, Sergey Krikalev and Helen Sharman left for Baykonur. General Leonov noted that the cosmonauts had fully coped with the flight and research programs. Viktor Afanasyev and Musa Manarov told journalists about impressions from their protracted mission. They described experiments in biology, bioengineering and technology that made up the bulk of their research efforts. Much time was devoted to the earth's visual observation and video recordings.

Musa Manarov, who has spent more time in zero-gravity than any other man on earth, told journalists that his adaptation to weightlessness was ten times faster and easier than during his first, 365-day mission. His previous experience proved helpful.

Helen Sharman said that finding oneself in zero gravity turned out to be quite pleasant. She said she experienced no negative sensations. As for earth's gravity, she said her arm felt unusually heavy straight after the landing, but the feeling passed very quickly.

Speaking about her impressions from the flight, Sharman said the earth looked huge and beautiful. "It becomes immediately clear when you look at the earth from up there how we earthlings must take care of it and cherish our earthly home".

Gorbachev Awards Cosmonauts

LD2605183791 Moscow Central Television First Program Network in Russian 1800 GMT 26 May 91

[From the "Vremya" newscast]

[Text] We have just received a decree by USSR President Mikhail Sergeyevich Gorbachev.

For carrying out the space mission, Viktor Mikhaylovich Afanasyev is being awarded the title Pilot Cosmonaut of the USSR. He is also being awarded the title Hero of the Soviet Union.

The order of the October Revolution is being awarded to Pilot Cosmonaut of the USSR Musa Khiramanovich Manarov, Hero of the Soviet Union.

Cosmonaut-researcher Helen Sharman, citizen of Great Britain, is awarded the Order of Friendship of the Peoples.

Her backup, cosmonaut-researcher Timothy Mace, citizen of Great Britain, is also awarded the Order of Friendship of the Peoples.

Leonov Notes Loss of Progress Capsule, Lack of U.K. Participation in Mission

LD2605195191

[Editorial Report] Moscow All-Union Radio Mayak Network in Russian at 1351 GMT on 26 May broadcasts a 4.5-minute report from the Space Flight Control Center. The program begins with the presenter reminding listeners that cosmonauts Afanasyev, Manarov, and Sharman landed in Kazakhstan today. Correspondent Leonid Lazarevich then interviews Aleksey Arkhipovich Leonov, deputy head of the Gagarin Cosmonaut Training Center, who gives a preliminary evaluation of the flight. Leonov says: "The flight program which was confirmed beforehand has, according to our summary of operations, been fully carried out. Now all of this must be deciphered: everything that has accumulated, what they have brought back with them. Timewise, though, everything has been done as was programmed." He goes on to note that Afanasyev and Manarov had been working for 175 days in space: telemetric data on their program was regularly transmitted back to Earth, "and they have brought some material with them now," he says. "Sad to recall, however, that the part relating to ecology and other experiments recorded on tapes—I didn't even want to say, I don't want to believe that it has been lost, but the capsule has still not been found." This material, Lazarevich recalls, was in the Progress craft which was lost, although, he says Leonov still hopes it may turn up in a lake somewhere.

Lazarevich notes that this was the only flight "when the second country participating in the flight prepared virtually no experiments at all; I'm not counting the communications link with the schoolchildren," he says, adding: "I am afraid that this has not added to the prestige of our space research, although Helen Sharman did of course work magnificently, and showed herself to be a really great girl."

Leonov reminds listeners of the history of the project: "When the program started, there were enough sponsors—as they are called now, that is, organizations which give money—on the British side. And we worked, and half of the money contracted was spent, and then, I don't know for what reasons, the sponsors got cold feet. We got to 1 January 1991, and the second half of the sum was not paid. One should not reckon everything in terms of money, there are some purely human relations, which are higher than all money, and then everything is compensated for. But is is bad that they did not put in any of their scientific equipment as was previously agreed, or they did not have time to do so, but their flight is completed."

Leonov concludes by noting that the two cosmonauts continuing on board the complex have a redocking ahead, and many space walks. The heaviest physical work they have to do is to move the solar batteries, weighing about 250 kilograms, from the equipment module and install it on the astrophysical module. Leonov says he has no doubt that the new crew will cope with their tasks, and in the first eight days of their flight have shown themselves to be feeling well.

'Progress M-8' Cargo Ship Launched 30 May

LD3005105191 Moscow TASS International Service in Russian 1031 GMT 30 May 91

[Text] Moscow, 30 May (TASS)—At 1104 today the automatic cargo ship "Progress M-8" was launched in the Soviet Union in accordance with the program for further work at the "Mir" science-research complex.

The aim of the launch of the ship is to deliver expendable materials and various freight to the "Mir" piloted complex.

The "Progress M-8" ship has been put into orbit with the following parameters:

- Maximum distance from the earth surface—249 kilometers:

- Minimum distance from the earth surface—191 kilometers:

- Period of revolution—88.6 minutes:

- Inclination - 51.6 degrees.

According to telemetry data, onboard systems of the automatic cargo ship are working normally.

'Soyuz TM-12' Redocked at 'Kvant' Module

LD2805202691 Moscow TASS in English 1233 GMT 28 May 91

[By unidentified TASS correspondent]

[Text] Moscow May 28 TASS—Cosmonauts Anatoliy Artsebarskiy and Sergey Krikalev today undocked the spaceship Soyuz TM-12 from the transfer module of the Mir orbital station and linked it to the astrophysical module Kvant, an operation envisaged by the flight program.

The reorientation of the orbital complex will facilitate future transport operations, including refuelling and delivering equipment and other cargoes by Progress unmanned craft.

Before today's operation, the commander and the flight engineer entered the transport ship and sealed the trapdoors. At 13:10 Moscow time the two spacecraft undocked. The cosmonauts manually controlled the flight of the orbital complex, approaching and docking procedures.

They also examined and photographed the basic unit and modules.

The Soyuz TM-12 spacecraft stayed away from the station for 42 minutes.

The cosmonauts continue to work on board the space research complex Mir. Both are feeling well.

'Progress M-8' Docks With Mir Complex

LD0106113891 Moscow TASS in English 1129 GMT 1 Jun 91

[Text] Moscow June 1 TASS—The Progress M-8 unmanned freighter docked with the Mir space station at 12:45 Moscow time today.

The resupply vehicle is attached to the station on the side of its air lock. The vehicle ferried fuel for the joint propulsion unit, equipment, new scientific equipment, drinking water, food and mail.

According to telemetry and reports by cosmonauts Anatoliy Artsebarskiy and Sergey Krikalev, the onboard systems of the Mir station are operating normally.

Accomplishments of Afanasyev, Manarov Reviewed

LD0405213391 Moscow TASS in English 1941 GMT 4 May 91

[By TASS correspondent Rena Kuznetsova]

[Text] Moscow May 4 TASS—Cosmonauts Viktor Afanasyev and Musa Manarov have been working at the Mir orbital complex for five months. They arrived at the orbital complex on December 4, last year, together with Japanese TV journalist Toehiro Akiyama.

The crew of the 8th main expedition fulfilled an extensive program of physical, astrophysical, technological, medical, biological and other experiments for various branches of the national economy.

There emerged some difficulties in their work. The unmanned cargo spacecraft progress M-7 brought a lot of trouble to the cosmonauts. They managed to dock it only after the third attempt on March 28.

The latest, fourth spacewalk on April 26, could hardly be described as a success. The examination of the aerial of the Quant module showed that the cosmonauts could not repair it themselves during the spacewalk.

The cosmonauts are now getting prepared to welcome the Soviet-British crew. The start of the Soviet-British space mission is scheduled for May 18.

Next Mir Module To Be Launched in Early 1992

LD0804183991 Moscow TASS in English 1816 GMT 8 Apr 91

[By TASS correspondent Rena Kuznetsova]

[Text] Moscow April 8 TASS—Soviet cosmonauts Viktor Afanasyev and Musa Manarov have been working in space for 127 days. A huge map at the Mission Control Center shows the flight's trajectory. A shimmering blue spot moving on the map is the Mir orbital complex with the members of the eighth main mission.

"The stellar home" includes the Kvant, Kvant-2 and Kristall modules, the Soyuz TM-11 spaceship and the Soyuz M-7 ferry which was a great headache both for Mission Center staffers and the cosmonauts.

All the ferries docked smoothly until now, but the fiftieth baulked. It docked only after the third attempt on March 28. The cosmonauts are now unloading it. Centre executives said that the space crew displayed high professionalism, self-control, and what is the main thing, mother wit under emergency conditions.

Understanding that the cosmonauts underwent great moral and physical strains (docking of the latest space ferry and three space walks), Center specialists say that the space crew's workload is extremely high.

This notwistanding, Afanasyev and Manarov offered to make the fourth space walkout in the interests of the Mir space station's life-supporting system.

Viktor Blagov, a Center official, told TASS that there are plans to enlarge the Mir complex. The Spektr module with optical equipment for zonal photography will be blasted off early in 1992.

It is planned to fire off the international Priroda ecological module late in 1992 or early 1993. This will certainly be an additional workload for cosmonauts.

The cosmonauts will work aboard the station on April 12 when all the world will mark the 30th anniversary of the first space flight by Yuriy Gagarin. They will perform a responsible work on that day: control over the adjustment of the station's orbit.

They will be holiday-making on April 13-14. On April 10, they will be congratulated by their cosmonaut colleagues, astronauts, members of the international association of space flight participants, who will gather at the Mission Control Center to mark the 30th anniversary of man's first flight in space.

Deputy Flight Controller Blagov Outlines Station Plans

LD1004210191 Moscow TASS in English 2044 GMT 10 Apr 91

[By TASS correspondent Rena Kuznetsova]

[Text] Moscow April 10 TASS—We intend to expand our Mir space station, Deputy Chief Flight Controller Viktor Blagov told TASS.

Early next year, he said, we plan to launch the Spektr module outfitted with optical equipment for zonal photography from space, and at the end of 1992 and the beginning of 1993 the Priroda international ecological module is due to be launched into orbit.

In the future we hope to build production facilities in space to carry out large-scale programs in the interests of various branches of the national economy. I believe that they will consist of reentry laboratory modules.

Teamwork on board mutli-purpose orbital stations will form the basis of the national space research program.

In this way, possibilities for research will be expanded and more complex tasks will be set for crews. Specialists say that these tasks will be too much of a burden for a crew of two to tackle.

I must say, Viktor Blagov continued to say, that the present crew has retained high work ability and interest in the fulfillment of the program. Viktor Afanasyev and Musa Manarov have already worked in open space three times and successfully coped with all the tasks. Recently they asked for the permission to work outside the space station for the fourth time. The Mission Control Center is prepared to comply with their request.

On April 12, when the 30th anniversary of man's first flight to space will be marked, the present crew will work aboard the Mir station. They are due to perform a very responsible task of modifying the craft's orbit. They will be able to take time off on April 13 or 14.

"Much complex and responsible work lies ahead," Viktor Blagov noted. "The ferry now docked to the station will have to be undocked and then drowned in the ocean. It does not seem to be too much of a task after 49 previous operations of this kind. But this time around, we used up all the fuel aboard the Progress ferry during the three attempts at docking and the Mir orbit can no longer be modified at the expense of the ferry. An original decision has been taken: This time the station will share its stock of fuel with the Progress craft and its engines will be used to push the station to a higher orbit".

Commentary on 'Salyut-7' Reentry, Intended Role of 'Cosmos-1686'-Type Modules

917Q0044 Moscow TRUD in Russian 23 Jan 91 p 4

[Article by B. Olesyuk: "A Bulky Space Object Falls to Earth: A Miscalculation by the Geophysicists, Astrophysicists, and Ballisticians?"]

[Text] Recently, our specialists in the space program reported that a bulky, 40-ton object flying in space—the Salyut-7 station linked-up with the Cosmos-1686 craft—will make an uncontrolled reentry into the dense layers of the atmosphere in February, and a massive 3-ton capsule will fall to Earth. Why did this situation arise? Was it unavoidable? Let us attempt to answer those questions.

Salyut-7 is the last in a series of stations with the name Salyut. They began in-orbit operations in 1971. Salyut-7 was launched in the spring of 1982. Crews worked aboard it regularly. The culmination was in June of 1985, when the courage and high professionalism of cosmonauts Vladimir Dzhanibekov and Viktor Savinykh helped save the station from certain destruction. Dead and frozen, it was resuscitated and literally brought back to life. The cosmonauts made the heart of the Salyut-7—its power supply system—work again. After that, the station functioned in orbit for some time.

In February of 1986, the third-generation station, Mir, was launched into space. The question arose, What should be done with the Salyut-7? It could be sunk in the usual waters of the world ocean, or, after being moved to a high orbit, it could be left in space for long-term useful-life tests. Voices resounded in favor of the first version. There was fuel in Cosmos-1686's tanks, the station was obeying commands, and there wouldn't be any difficulty in sending the 40-ton bundle into the ocean.

But the designers wanted the station to stay aloft in space for several more years, after which its units could be returned to the ground with Buran. The stellar path designers, as if by order, issued an optimistic prognosis: Salyut-7 would be able to stay in orbit until 1994. It was as i they forgot what even a schoolboy knows: solar activity changes every 10-11 years. Streams of high-energy solar particles rush toward the Earth. Under their pressure, the planet's magnetic field "sags," the radiation belts become deformed, and the atmospheric density changes, all of which would inevitably affect Salyut-7's orbit.

Be that as it may, the version for preserving the station was adopted. The fuel was expended in order to move it to a higher orbit.

Today, now that our specialists in the space program find themselves in a very unpleasant situation, they allude to the fact that, so they say, the solar activity turned out to be unusually great, and it couldn't have been predicted, and that is why, three years before the end of the calculated time period, the station will have to cease flying. Meanwhile, it was quite possible to foresee such a turn of events, based on just the Americans' experience.

A similar problem confronted the U.S. specialists when they were deciding in 1974 the fate of their own orbital station, Skylab. After the return of the third and last crew, all operations with it were halted. The American ballistics experts believed that, at a 500-kilometer altitude, the station would be able to survive until the beginning of 1980. By that time, the Space Shuttle would have begun operations, and it could be used to solve all their problems. The shuttle itself would deliver a booster unit for raising the orbit.

It must be noted that the engineers across the ocean committed an unforgivable mistake when they designed Skylab: they did not equip the station with a propulsion system. However, they figured that the station would remain in orbit for six years.

Soon thereafter, all the calculations of the space navigators crumbled to dust. The sun "rebelled," the atmosphere was disturbed, and the station began to descend rapidly.

In 1979, during reentry, it flew over Australia in fiery ball and burned up in the atmosphere. Unburned fragments fell into the Indian Ocean and on sparsely populated regions of western Australia.

Everyone knows that it is better to learn from others' mistakes than from one's own. It looks like our specialists banished that golden rule to oblivion and failed to take into account their American colleagues' sad experience. We also moved the station to an almost 500-kilometer orbit and hoped that it would stay there for eight years. But both the Americans' calculations and ours proved to be wrong. Skylab flew on automatic for something over five years, and our Salyut-7, for four and a half years.

There is reason to ask, Who is at fault for such a gross error? The responsibility, apparently, should be shared by various types of specialists: astrophysicists, geophysicists, and ballistics experts.

In the past, quite a few space vehicles have reentered the atmosphere and burned up. But, in this instance, the situation is special. What is causing alarm is the 3-ton landing capsule on Cosmos-1686, which is capable of reaching the Earth's surface undamaged. How does the vehicle come to have a landing capsule? The space vehicles Cosmos-929, -1267, -1443 and -1686, which were listed in the press as heavy-class cargo ships, were capable of serving as manned craft. At the time, they were built not in the design bureau where S. P. Korolev worked, but in another. But, because of "cloakroom" intrigues, those ships never went aloft with a crew on board. Supply transport craft is their actual title.

This calls to mind how, after the latest failure of a Soyuz to dock with Salyut, Aleksey Leonov blurted out in a fit of temper: "What a pity they didn't make room for that small Apollo."

Yes, the ship was good in many respects. It could deliver to orbit up to three tons of dry goods, which is twice what the Progress craft carries. In addition, there is more than a ton of fuel in the ship's tanks for raising an orbit.

Thus, the ship was capable of playing the role of a cargo-passenger transport system on the Earth-Space-Earth route. You'd think that the supply transport craft would be good today for delivering supplies and the needed number of people to the present-day orbital complex.

But, as the saying goes, every cloud has a silver lining. The ship managed to undergo its baptism by space and prove its reliability. Later, based on it, they began to build the modern modules with which the Mir is being assembled.

Let us return, however, to Salyut-7 and the Cosmos-1686 docked with it. When will they fall? According to the estimates of the ballistics experts, somewhere between the February 2 and 12 [1991]. They won't be able to name a specific date for two-three days.

And what is the condition of the Salyut-7 today? It's hard to believe this, but the station has shown surprising tenacity. As before, the power supply and telemetry systems are operating, as is the command radio link. Twice a day, the Mission Control Center is carrying on a lively conversation with Salyut-7 in the language of radio signals. Are other systems in good condition? The answer requires verification tests. Unfortunately, the Cosmos-1686 ship fell silent about a year ago.

Many people are interested in knowing whether there is a chance of helping the space veteran. No, Salyut-7 is doomed. It will fall to Earth within a narrow strip between 51°N latitude and 51°S Latitude. God willing, the remnants of Salyut-7 will fall in unpopulated regions.

Results From Study of X-Ray Pulsars by Astron Observatory

917Q0066B Moscow ZEMLYA I VSELENNAYA in Russian No 6, Nov-Dec 90 pp 3-12

[Article by V. G. Kurt, doctor of physical and mathematical sciences, and Ye. Yu. Shafer, Astrospace Center, Physics Institute, USSR Academy of Sciences, under the rubric "Astronomy": "'Astron' Studies X-Ray Pulsars"; first paragraph is source introduction]

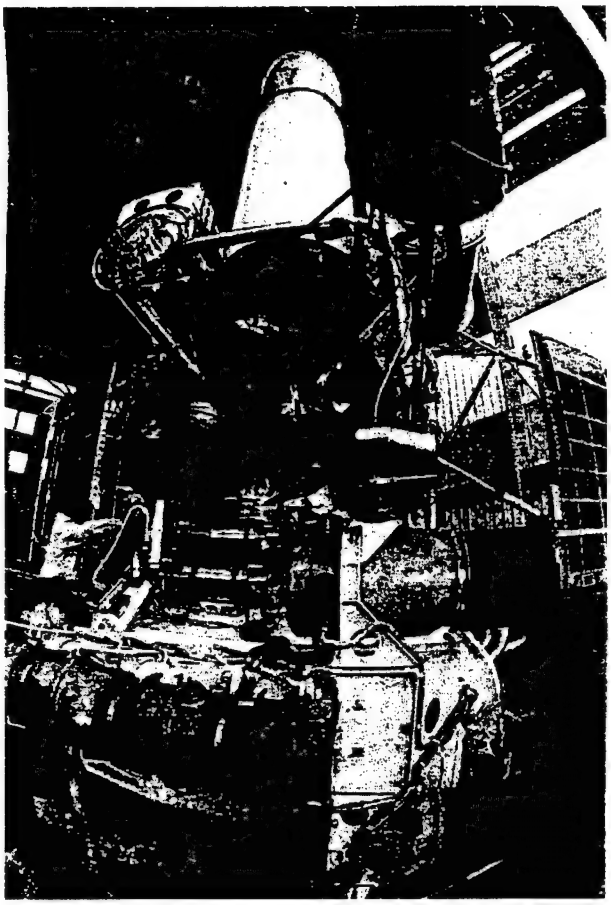
[Text] **X-ray pulsars, being neutron stars or, possibly, black holes, are being investigated intensively with ground-based and spaceborne telescopes operating in the optical and X-radiation ranges. Valuable data on those astonishing stars have been obtained from the Astron station, the country's first specialized astronomy satellite.**

X-ray pulsars are an extremely popular subject in astronomy. Every year, the hundreds of articles that appear in the best and most prestigious journals, plus the international conferences and symposia that are held, are a sign of the universal recognition of their popularity. We feel that that is attributable to two circumstances: the newness and brilliance of the discoveries in the world of pulsars, and the relatively rapid success in understanding their nature. Very few newly discovered astronomical objects have received such a rapid and correct interpretation. Two good examples are quasars and gamma bursts. They have been studied sfor about 20 years, but to this very day, they are not clearly understood.

X-ray pulsars were discovered in 1970 from the world's first X-ray satellite UHURU (United States), and since that time they have been investigated intensively by all X-ray and gamma-ray satellites. Particular mention should be made of the American CAC-3, HEAO-1, and HEAO-2 (Einstein Observatory) satellites; the ANS satellite of the Netherlands; the Japanese X-ray observatories Hakucho, Tenma, and Ginga; and European Exosat satellite (ZEMLYA I VSELENNAYA, 1989, No 5, p 30). We should say at once that such a massive assault of space hardware was successful only because of the powerful support provided by ground-based optical astronomy. The precise determination of the coordinates of the X-ray pulsars (first in degrees, then in minutes of arc, and now in seconds of arc) has made an optical identification of many of them possible, which, in turn, has enabled "optical observers" with medium and large telescopes to investigate the optical components of X-ray pulsars, i.e., obtain their spectra and study their variability in an enormous range of periods: from milliseconds (1 ms = 0.001 s) to a year! That very combination of optical and X-ray data has helped us to understand the nature of X-ray pulsars and the mechanisms of their optical and X-ray emissions. Of course, it would be foolish conceit to think that we know everything about X-ray pulsars. The number of unsolved problems increases the more we study X-ray pulsars.

So Just What is an X-Ray Pulsar?

A concise answer is simple and clear: it is a neutron star, i.e., an object with a radius of 10-20 km and a mass of about one solar mass. A total of about 30 X-ray pulsars have been discovered. It is possible that some of them will turn out to be black holes. Their calling card—*intermittent pulsations of X-ray emissions, with a constant or almost constant period.* The range of periods is enormous: from several milliseconds to 1000 s, i.e., almost 5 orders of magnitude. Radio pulsars have a much smaller spread of periods. It falls in the range of 1.557806449014 ms for the fastest radio pulsar PSR 1937+216 to 4.30877928 s for PSR 1845-15. One of the brightest X-ray pulsars, which, incidentally, has the shortest period, is situated at the center of Crab Nebula, which appeared as a result of explosion of a supernova in the year 1054. Its period is 33 ms.



Astron artificial earth satellite.

Almost all the X-ray pulsars (except for three) are part of binary systems in which the second optical component is a normal star, most frequently a giant or supergiant. Observations make it possible to measure the pulsation period (P, s), its variation, the orbital period of the system (for binary pulsars) P_{orb}, the apparent magnitude and spectrum (or color) of the optical component, and the light curves, including eclipsing, when the X-ray source is hidden behind the optical component or appears from behind it. Obviously, the eclipses in a binary system can be observed only when the line of sight lies in the orbital plane, or almost in the orbital plane, of the binary system. During orbital motion, the period of the X-ray pulsations varies in a small (but clearly noticeable) range with a period equal to P_{orb}. That is a result of the Doppler effect, since an X-ray pulsar moves toward the observer and then away from him. We should note right away that the velocities of orbital motion (V_{orb}) in the systems under observation are very great and reach 400 km/s (this is about 10 times greater than the velocities of revolution of the planets around the sun). The body of mathematics that has been developed for analyzing the binary stars makes it possible to find almost all the parameters of the binary system and, in particular, the masses of both components—M_x for the X-radiation source (neutron star) and M_{opt} for the optical component. However, if that analysis cannot be done, it is possible to compute the mass function equal to

$$M^3{}_{opt}\sin^3 i/(M_x + M_{opt})^2$$

where i is the angle between the normal to the orbital plane of the binary system and the line of sight.

It is very difficult to determine the distance to pulsars. Usually, it can be only roughly estimated from the apparent and absolute magnitudes of the optical component of the binary system or from the "sag" of the spectrum of the X-radiation source in the soft region of the spectrum, i.e., for photons with an energy of less than 3-4 keV. Almost all X-ray pulsars are extremely far from the sun. The distances exceed 3-4 kps (10-12 light years). The only exceptions, perhaps, are three objects: the pulsar in the Crab Nebula, X Perseus, and Vela X-1. The orbital periods of X-ray pulsars fall in a very broad interval: from 41 minutes to 580 days. As already mentioned, we know of only three individual pulsars. They are the pulsar in the Crab Nebula (Taurus X-1); LMC 0540-69 (pulsar in the Large Magellanic Cloud) with a period 0.0502 s; and MSH 15-52, with a period 0.150 s. LMC 0540-69 is an almost complete analog of the pulsar in the Crab Nebula. The masses of X-ray pulsars are not determined very precisely; they fall in the range 0.5-2 solar masses; the masses of their optical partners, however, can be determined far more precisely. The range of the optical components is great: from 0.1 to 30 solar masses. For most of the X-ray pulsars (15 of 25), the companions are hot supergiants with a mass greater than 10 solar masses and a luminosity greater by a factor of 10^3-10^5 than that of the sun. The radii of these giants of the star world also are very great. They exceed 10-30 solar radii. The record evidently belongs to the system GX 301-2, with a star radius of 40 solar radii. Its orbital period is 41.4 days, and the semimajor axis of its orbit is 0.74 a.u. With rare exception, the orbits of binary X-ray pulsars are almost circular, with little eccentricity.

X-ray pulsars are the source of an enormous flux of hard X-radiation (greater than the total luminosity of the sun by a factor of 10^3-10^5) via two mechanisms. One of the mechanisms is responsible for the emissions of the neutron star itself. It is regarded as essential for such sources and is linked to the fantastic magnetic field of the neutron star, whose strength is 10^{11}-10^{13} G. We recall that the strength of the Earth's and the Sun's magnetic field is only about 1 G, and the field strength in sunspots reaches 10^4 G. X-ray luminosity is the result of the motion of high-energy electrons in the magnetic field of a neutron star. The second mechanism of X-radiation generation in a binary system is linked to the flow (accretion) of matter from the optically normal star to the neutron star. Since the star participates in orbital revolution, the incident matter carries with it an angular

momentum, as a result of which an *accretion disk* forms around the neutron star; the temperature of matter in the disk reaches 10^7 K. The incident matter is completely ionized, is captured by the magnetic field of the neutron star, and, being accelerated almost to the speed of light, falls toward the star's magnetic poles. In the process, an enormous amount of energy is released, sometimes exceeding the total luminosity of a blue supergiant. Picture that! An object with a radius of 10-20 km, plus two jets measuring anywhere from a hundred to a thousand kilometers, i.e., smaller than the Earth, and this cosmic dwarf emits shines several thousand times more intensely than a blue supergiant with a radius 10 million kilometers! That is really amazing.

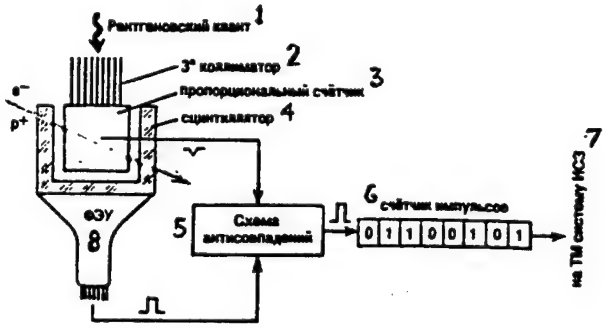
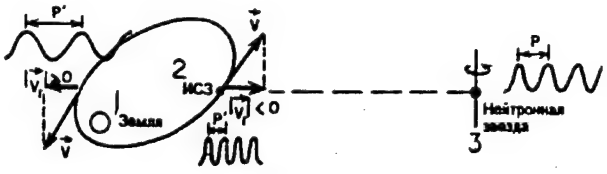


Diagram of SKR-02m X-ray telescope.

Key: 1. X-ray quantum—2. 3° collimator—3. Proportional counter—4. Scintillator—5. Anticoincidence circuit—6. Pulse counter—7. To telemetry system of satellite—8. Photomultiplier tube

The model we presented for an X-ray pulsar explains quite well almost all the features that have been observed in those objects. Pulsating X-radiation is produced as a result of the rotation of the neutron star in regions close to its magnetic poles. We should note that the magnetic axis may not coincide with the axis of rotation. The accretion disk ensures a constant or almost constant emission of X-radiation by the system. A blue giant or supergiant is responsible for the optical emissions and is partially responsible for the X-radiation. Since the X-ray source (the neutron star) is situated very close to the surface of the giant (frequently at a distance that is less than its radius), one hemisphere of the star is illuminated on the outside by an enormous flux of X-radiation. This flux may exceed by a factor of 100 the self-radiation flux of the star. Some of the X-radiation is reflected, but some reworked by the star atmosphere into optical and ultraviolet radiation. The temperature of the star hemisphere illuminated by the X-radiation rises by several thousand degrees, so that the two hemispheres of the star have different temperatures. Their spectra, of course, also differ. These effects are clearly observed in the optical, UV and X-radiation ranges, which is extremely important for understanding the physical processes associated with the scattering and reflection of X-radiation by the star atmosphere.



A single X-radiation source (neutron star) emits a strictly periodic signal with a period P. A satellite-borne X-ray telescope records the period P', which may be greater or less than P, depending on the sign on the value for the projection of the satellite's velocity of motion onto the line of sight.

Key: 1. Earth—2. Satellite—3. Neutron star

Observations of eclipses of an X-ray source by the disk of an optical star and determinations of the moments of entry into and emergence from the eclipse are very interesting because they make it possible to estimate the angle of inclinatio of the orbital plane to the line of sight (i) and the size of the giant, and they make it possible to investigate the giant's atmosphere when it is transilluminated by the X-radiation of a neutron star. In short, all the phases from one eclipse to the next are of great interest. X-ray observations are particularly valuable if they are accompanied by synchronous optical observations made with large ground-based telescopes. We have already managed to accumulate an immense volume of highly accurate data. For example, the period of the source in the constellation Hercules (Hercules X-1 and its optical component, which has long been known as the variable star HZ Her) was equal to P = 1.23779226 + (2 x 10^{-7}) s in April 1984 (2445798.11 YD), but the orbital period was P_{orb} = 1.700167788 day. And that is still not as accurate as it can be. A good physical model has been constructed for that source: a neutron star with a mass of 1.45 + 0.4 solar masses, and a great-sequence star of the spectral class BO with a mass of about 2 solar masses and a radius of 4 solar radii. For that source, in addition to the pulsations and orbital period, yet another period is observed, one that is equal to 35 days and for which there is yet to be an explanation acceptable to everyone. Nor is the nature of the unexpected cutoff of the source, discovered on 30 June 1983 by the Astron observatory, clear. There are still more than enough such mysteries in the world of X-ray pulsars.

Astron Observes X-Ray Pulsars

Now, using the Astron as an example, we will demonstrate how astronomers are investigating X-ray pulsars. Of course, the satellites and X-ray telescopes themselves differ somewhat, and their orbits differ, and different data processing programs are used. But the differences are not so essential for understanding the big picture (ZEMLYA I VSELENNAYA, 1984, No 2, p 26).

The Astron artificial earth satellite was launched into a high-apogee orbit on 23 March 1983, and it operated

successfully until the summer of 1989, thereby establishing an absolute record for duration of operation among all the Soviet scientific vehicles. The satellite carried two large scientific instruments: the *ultraviolet telescope (UVT) of the Crimean Astrophysical Observatory, USSR Academy of Sciences,* with a main-mirror diameter of 90 cm, and our *SKR-02m X-ray telescope.*

The sun-seeker/star-tracker system ensured a pointing accuracy toward the source under investigation of about 1-2' for the X-ray telescope and 0.3" for the ultraviolet telescope. Before the launch of Astron, the Soviet Union had no specialized astronomical satellites equipped with such a pointing system.

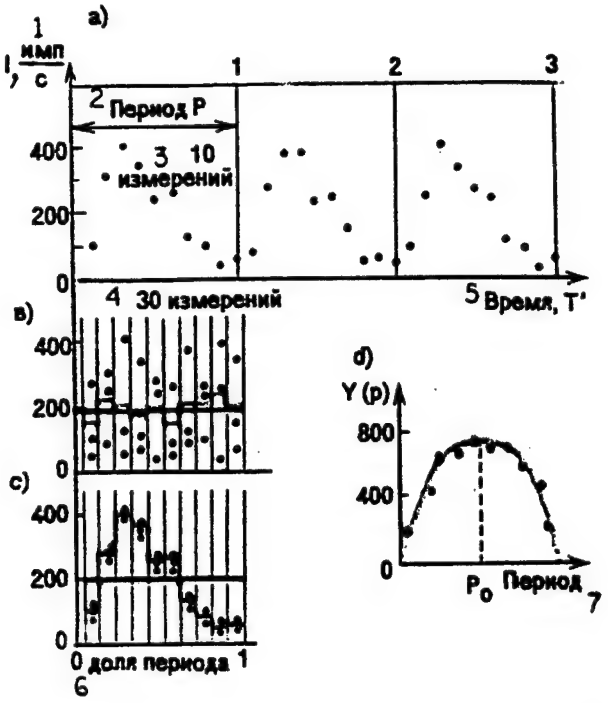


Diagram of computer processing of X-ray pulsar signal emitted with period P in time system "at source" T': (a) intensity of X-radiation signal as function of time T'; (b) all points are superimposed on first impulse with poorly selected period, averaged signal almost does not differ from horizontal straight line, and spread of points in all ten intervals is great; (c) period is selected correctly, spread of points is small, but solid curve differs greatly from horizontal straight line; (d) method for determining best value of period P_0.

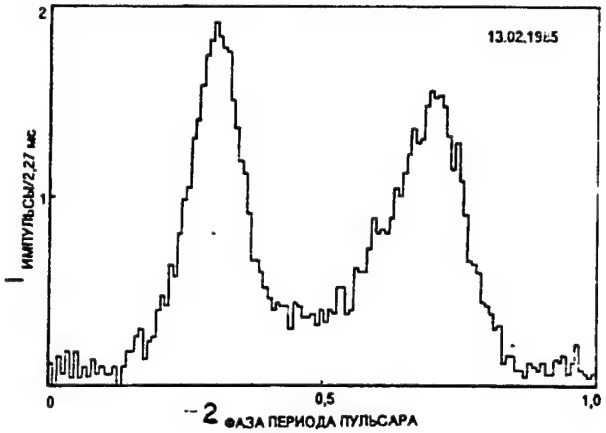
Key: 1. I, pulses/s—2. Period P—3. 10 measurements—4. 30 measurements—5. Time, T'—6. Fraction of period—7. Period

The detectors used were proportional gas-filled X-radiation counters with an area of about 2,000 sq cm, sensitive in the energy range of 2-25 keV or in the wavelength range of 0.5-6 angstrom units. The X-radiation of the sources was recorded in 11 spectral bands whose width increased slightly in the direction of greater energies. The field of view of the counters was limited to 3° by a mechanical honeycomb collimator (an assembly of hundreds of small hexagonal tubes 5 mm in diameter and 100 mm long). In order to decrease the background from the charged particles of cosmic rays, which was equal to approximately 4 particles/sq cm/s, the counters were surrounded by a plastic scintillator (a substance similar to plexiglas) 2 cm thick. When a charged particle of adequately high energy hit the screen, it caused a brief light flash, which was registered by four photomultiplier tubes. At this point, the pulses of the X-ray counters were blocked by means of an anticoincidence circuit and were not fed to the registry circuit. The pulses that went through and were not blocked were registered by an 11-channel digital counter with a capacity of 2^9 pulses. All the counters were interrogated each 0.305 s, and the entire channel, each 0.00227 s. We will assume that the state of the counter corresponds to 166 registered pulses (2 + 4 + 32 + 128), which corresponds to Fig. 2. For example, if the binary number 10010111, that is, 233 = 1 + 8 + 32 + 64 + 128, is registered in the next telemetry frame, the counting rate will obviously be equal to (233 - 166)/0.305, or about 220 pulses/s. A very short interrogation time, equal to 2.27 ms, enabled us to investigate all the pulsars, including those with the shortest periods. That was an important factor in success of the experiment.

The Astron always operated in a "direct transmission" (DT) mode, i.e., without the data being recorded in an on-board memory unit. The DT mode has its advantages and disadvantages. The advantage is a high information density and the capability of monitoring the course of the session at all times. The disadvantage is its inability to observe sources when the satellite is outside the range of visibility from the receiving station. That station was the Deep-Space Communications Center (DSCC) in the Crimea. During one five-hour session, some 7 megabytes of information could be transmitted "to Earth." Unfortunately, the DSCC was heavily overworked. Suffice it to recall that during the period in which Astron was active, a brilliant experiment was carried out involving the radar mapping of the Venusian surface (Venera-15 and Venera-16 stations), a flight was made to Halley's comet (Vega-1 and Vega-2), and the two Fobos probes were launched. Over all those years, the Astron observed hundreds of sources of X- and UV radiation continuously, without any malfunctions of the scientific instrumentation or support systems. There were more than 600 communication sessions with it, and they lasted a total of more than 3,000 hours; 100,000 commands were sent and executed.

At the receiving station, all the information was recorded on magnetic tape, where the ground, "station" time, kept by the country's time standards, was also recorded. That ensured an accuracy in time referencing within +1 ms. However, for **determining time on the satellite,** the time had to be scaled during the processing, by introducing a correction t = L/c, where L is the distance from the

satellite to the receiving station and c is the speed of light. The L value was computed from the orbital elements of the satellite, which were computed on the basis of data from the trajectory measurements that were made during every communication session. That was the beginning of the data processing. The spectrum of the X-radiation sources was computed from 10 spectral channels. Usually, the spectrum was characterized by three parameters: temperature, number of absorbing atoms on the line of sight in the Galaxy between the observer and the source, and the normalization factor. Three other parameters, determined by the form of the spectrum, were selected for many sources with a nonthermal spectrum. The type of spectrum, i.e., the dependence of intensity on wavelength, was assigned by the researcher in the course of data processing.



Light curve of X-ray pulsar Taurus X-1 (P = 0.033 s).

Key: 1. Pulses/2.27 ms—2. Phase of pulsar period

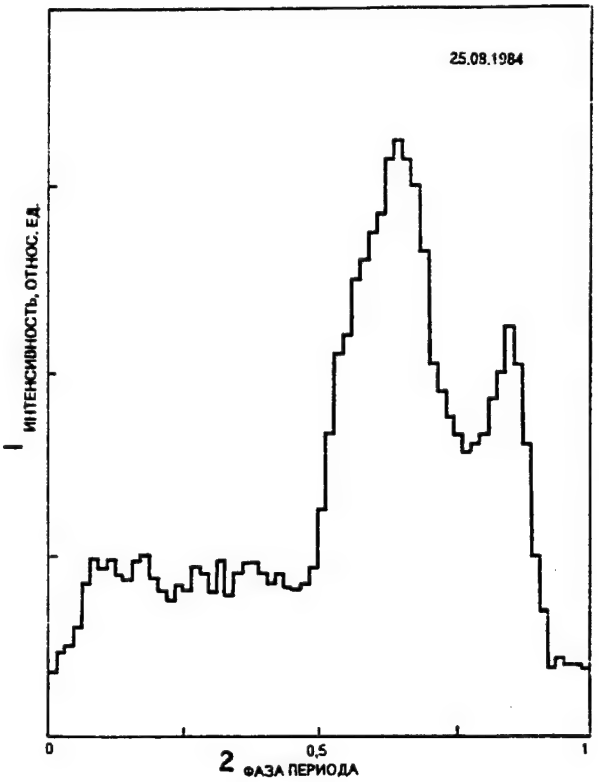
An equally interesting procedure is that of **determining the period of the pulsar and constructing the light curve** obtained by a superposition of all the pulses observed during a session on the first arriving pulse. If a precisely periodic signal emitted by a pulsar is observed from a satellite, the X-ray telescope shows us that neither its period nor its frequency remain constant. That is attributable to the fact that the satellite and source move relative to one another, and the velocity of that motion does not remain constant in magnitude or direction. A frequency shift occurs (the Doppler effect). The period observed on the satellite $P' = P \times (1 + V_r/s)$, where V_r is the radial component of the velocity vector and P is the true period "at the source," which would be recorded by an observer if he were situated on the neutron star. When the radial component of velocity is directed toward the source, P' will be less than the true period; otherwise it will be greater. In actuality, a satellite participates in motion of three types; rotation of the neutron star about the center of gravity of the binary system, motion of the Earth relative to the sun (to be more precise—the barycenter of the solar system), and motion of the satellite around the Earth. Only two motions remain for single pulsars (because of the motion of the Earth and satellite). All three corrections must be computed with the maximal possible accuracy and must be introduced in the processing. That is usually not done entirely as was indicated above. Usually, it is more convenient to convert from the time "on the satellite" to the time "at the source." After that conversion, the pulsar period can be considered almost constant. Almost constant, because over a long period of time—several days, or weeks or longer—the period itself of rotation of the neutron star changes. If a period equal to P is chosen, all the points are successively shifted, being superposed on the first impulse. The time T' is replaced by a phase varying from 0 to 1 and equal to the value T'/P - INT(T'/P), where P is the sought-for period of rotation of the neutron star, the symbol INT denotes the "whole part" of the fraction (T'/P). The period is divided by a whole number of intervals n, for example, equal to 10, but in real processing to 32, 64, 128, or, for bright pulsars, even 256. Since in Fig. 4 we assumed n = 10, but the total number of points is 30, in each interval there were three points. If we guessed the period P poorly, the curve would differ little from a horizontal straight line and the spread of points in each of the 10 intervals would be very great. Taking other values, one can, finally, obtain such a period for which the spread of points in each of the 10 intervals will be minimal, whereas the amplitude of the brightness oscillations is maximal. To find that value precisely, a simple function is introduced which is equal to the sum of the squares of the difference between the average intensity in each of the ten intervals and the average intensity I for the entire session:

$$Y=(1/\bar{I})\cdot\sum_{i=1}^{10}(I_i-\bar{I})^2$$

Letter "I" with bar over it represents avg. intensity for entire session

The Y(P) dependence is similar to the parabola $Y(P) = aP^2 + bP + c$. Finding the values a, b and c for several tens of thousands of points (the least squares method exists for that), we compute the period P_0 for which the Y(P) function has a maximum of $P_0 = -(b/2a)$. Now it is easy to obtain the average light curve for the pulsar, superposing all measurements on the first impulse. It is with that value of the period that the shape of the impulse will be most contrasting, i.e., with the maximum ratio of the maxima to the minima. All the narrow details of the impulse are seen best.

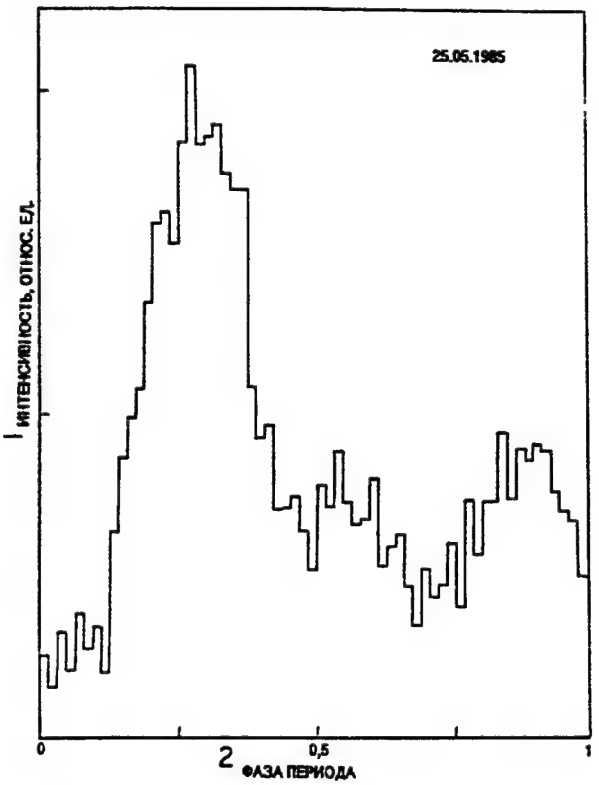
For testing the method, for checking the operation of all the programs, and for checking the stability of the position of the spectral channels and their boundaries, we annually observed the pulsar in the Crab Nebula (Taurus X-1), whose period has been investigated well on the basis of radio data and can be predicted precisely. For example, according to data from the session of 16 March 1984, the period is equal to 0.033295355 $\pm$



Light curve of X-ray pulsar Hercules X-1 (P = 1.24 s)
Key: 1. Intensity, relative units—2. Phase of period

0.000000003) s. In a prediction, of course, not everything is so simple. Once every several years, the pulsar in Crab gives rise to "an interruption," and its period changes in a jump. Such jumps, unfortunately, cannot be predicted.

The accuracy in determining the period is dependent on the duration of the session, the brightness of the X-ray source, and the shape of its impulse. That value can be estimated with the formula $\Delta P/P = \Delta t/T$, where ΔP is the sought-for accuracy, P is pulsar period, Δt is accuracy in measuring time, and T is the duration of the session. For example, take the pulsar Hercules X-1, with a period of 1.24 s. Assuming that $\Delta t = 2$ ms and that $T = 10^4$ s (three hours), we find that $\Delta P = 3 \times 10^{-7}$ s. The real accuracy will be worse by a factor 3 or so, i.e., about 10^{-6} s. How so, you ask? After all, the accuracy in time referencing is only 2 ms, whereas the error we found is less by a factor 10^4. The answer is simple: it is a matter of the duration of the session. It will not surprise you that the accuracy in determining the time of passage of details on Mars across the planetary central meridian does not exceed a half-hour, but we already knew the period of Martian rotation 90 years ago with an error 0.1 s. It is, of course, all a matter of the duration of observations, but for Mars it is about 200 years! Substituting into the derived formula the values for Mars—$\Delta t = 2000$ s, P = 24 hours, T = 200 x 365 x 24 x 3600 s—we find that $\Delta P = 0.03$ s! For the pulsar Taurus X-1 with a period of 0.033 s, the ΔP error is equal to 7×10^{-9} s.



Light curve of X-ray pulsar Centaur X-3 (P = 4.84 s).
Key: 1. Intensity, relative units—2. Phase of period

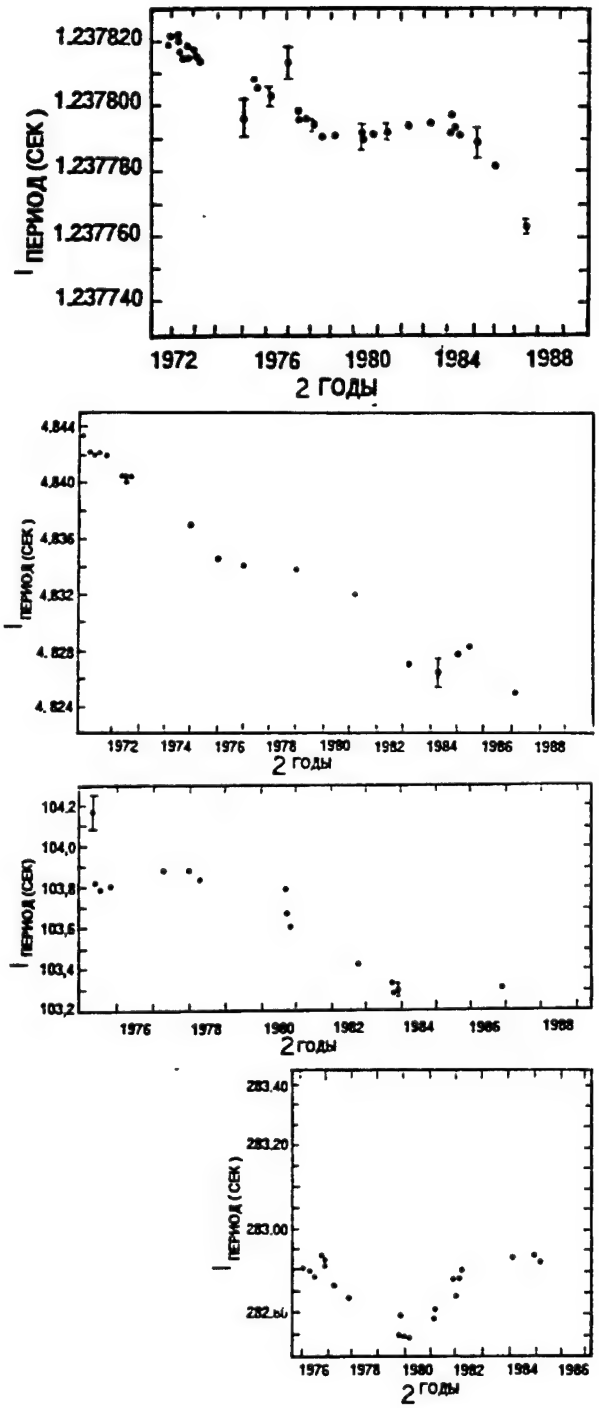
If two sessions separated by a time interval of several days are "spliced together," the error will be still less. One needs only know the period in advance with such an accuracy as to not err by +1, +2, +3... impulses. One also needs to be sure that during that time the period has not changed by a value greater than the estimated error. About 1 million points are involved in the actual processing. For example, for the pulsar Hercules X-1, with n = 64, an average of 15,000 points within each interval, which gives a very high statistical accuracy (at the light curve maximum, the error does not exceed 0.1 percent).

Observation Results

Now that we know almost the entire "kitchen" of processing of observational data, we will familiarize the reader with the results of pulsar research. To be sure, the period of pulsations P and the orbital period P_{orb} are of the greatest interest. Do these values remain constant after allowance for the total Doppler effect from all motions? Certainly not. It is known from mechanics that the velocity of rotation of a top (and a neutron star-pulsar is an ideal top) remains constant only if the top is

not slowed and does not precess. A neutron star, however, may experience both slowing and precession. Acceleration, i.e., a decrease in period, occurs as a result of the movement of matter from the rotating accretion disk onto the star surface. The angular momentum imparted by the falling matter spins the star in a manner similar to the acceleration of rotation of a figure skater or ballerina when she presses her arms against her body. Slowing, however, arises because of the transfer of angular momentum to the ambient matter, which is associated with the presence of a strong magnetic field at the star. And that balancing at the edge of "slowing-acceleration" occurs in almost all pulsars. The pulsar Hercules X-1 is, generally, accelerating, although from 1978 through 1983 it slowed slightly. The pulsars Centaur X-3 and A1627-673 are at all times accelerating. The source Vela X-1, with a period 283 s, accelerates by 0.2 s for approximately 5 years and is then slows down. The X-ray pulsar AO535+26, with a period 104 s, is very interesting. It is generally accelerating, although there are also periods (1975-1978 and 1983-1986) of slowing. That source is usually very weak; the flux of X-radiation from it is about 1/1000 of the flux from the pulsar Taurus X-1 over 75 percent of its orbital period, which is 110.5 days. On the other hand, for 10-15 days, it radiates at the level of the pulsar in Crab, i.e., it becomes a thousand times brighter that it usually is.

For several days, its period decreases by 0.1-0.2 s and then, when we do not observe it, it again increases to almost its former level. It happens that after a burst of brightness lasting 10-20 days, the period cannot be determined it is too weak. But the source A1627-673 accelerates with a surprising constancy—1.43 ms per year. There are more than a few such mysteries in the world of pulsars. Here is still another. Many pulsars (Taurus X-1, Hercules X-1, Centaur X-3, A1627-673 and others) have a "double-humped" light curve; the intensity peaks are frequently different. It is assumed that one maximum is associated with one magnetic pole of the neutron star, and the other maximum with its opposite pole. Many effects are attributed to the accretion disk tilted to the line of sight. The disk rotates and oscillates and is "twisted." That is why both poles are visible through the disk. However, it is not easy to explain why the two maxima are not situated precisely 180° apart on the light curve, for example, for the pulsar A1627-273. It could be postulated, of course, that the magnetic dipole within the star is shifted relative to the star's center, similar to what is observed on Uranus. That explanation is fairly good, but also extremely artificial. It is far more difficult to explain the highly irregular shape of the light curve of the pulsars Vela X-1 and AO535-26, on which there are a great many details "sitting" stably in their places. How can one explain the complex shape of the beam of the X-ray searchlight the "flashes" in the observer's eye? There are many such questions.



Change in periods of X-ray pulsars over last decade: (a) Hercules X-1; (b) Centaur X-3; (c) AO535+26; (d) Vela X-1.

Key: 1. Period (sec)—2. Years

Principal Parameters of Nine Bright X-Ray Pulsars That Are in Binary Systems

Pulsar	P,s	P_{orb}, days	M_X, in solar mass units	M_{opt}, in solar mass units	R_{opt}, in solar radius units
SMC X-1	0.714	3.892	1 ± 0.4	18	16 ± 4
Hercules X-1*	1.24	1.70	1.45 ± 0.4	2	4 ± 0.3
Centaur X-3*	4.84	2.087	1.7 ± 0.6	19	12 ± 3
4U 1625-67*	7.68	0.029?	0.5—5	0.1	?
LMC X-4	13.5	1.408	2 ± 1.5	17	9 ± 4
AO535+26*	104	110.5	?	25	?
Vela X-1*	283	8.965	1.85	24	30
4U 1538-52	529	3.73	2 ± 1	19	16 ± 5
4U 0352+30*	835	580?	?	20	?

*pulsars observed from Astron

Does the orbital period of a binary system remain constant? It turns out that it is rather difficult for it to change. P_{orb} will change if, in the system, there is an appreciable flow of matter from the optical component to the neutron star or of if some mass of the binary system is lost to the outflow of matter into the interstellar medium. The X-ray luminosity of a pulsar is easily computed with the formula $L_x = 0.15 \times M \times s^2$. The factor 0.15 is the efficiency of the process of energy release accompanying accretion on the neutron star. We should note that that is its maximal value. For example, in the nuclear reactions that take place in the interior of a star, the efficiency is only 0.01. Consequently, accretion on neutron stars is the most efficient process of transformation of matter into energy in physics.

The world of pulsars is very diverse. Pulsars may be single neutron stars (remnants of young supernovas) or "neutron star-supergiant" pairs. The sizes of both stars and the distances between them are astonishing. For example, what about the pair Centaur X-3! The mass of the blue giant of the spectral class O6 is 20 solar masses. Sometimes its turbulent atmosphere swells so much that the neutron dwarf, with a mass of two solar masses, is literally immersed in it. The distance between the components is 10 times less than an astronomical unit, whereas the radius of the giant is 10 times greater than the solar radius. And the pulsar Vela X-1! The radius of the blue supergiant in this pair is equal to approximately 30 solar radii, and its luminosity is greater than that of the sun by a factor 10^4. Is this not something for the Guinness Book of Records?

I want to end the article on an optimistic note. Despite the successes we have achieved in understanding the world of X-ray pulsars, a great many mysteries remain. There is enough work to be done to last many years both in space and on Earth.

Flight Experience of Cosmonaut-Physician Polyakov

917Q0065 Moscow ZEMLYA I VSELENNAYA in Russian No 6, Nov-Dec 90 pp 32-36

[Article by Doctor of Medical Sciences I. I. Kasyan, Flight Control Center: "Into Orbit—in a White Smock"; first paragraph is source introduction]

[Text] **The author of this feature has frequently had occasion to meet with USSR Pilot-Cosmonaut Dr. Valeriy Vladimirovich Polyakov during joint work in the Biomedical Problems Institute, during training sessions at Zvezdnyy Gorodok, and in the Flight Control Center.**

Cosmonauts Are Not Born...

On 29 August 1988, the Soyuz-TM-6 spaceship lifted off. Its international Soviet-Afghan crew included a physician-researcher, Valeriy Vladimirovich Polyakov.

Almost a quarter of a century separated that lift-off from the date of 12 September 1964, when Valeriy Polyakov, a fifth-year student of the First Moscow Medical Institute, after learning of the flight of Dr. Boris Yegorov as part of the crew aboard the Voskhod craft, decided to devote himself to space medicine.

First came work in the scientific research institutes, graduate studies, and preparation of his dissertation. And the whole time, the dream about a flight into space never left. Day after day, Valeriy came closer to the goal he had set for himself. Time and again, he underwent additional professional training. He mastered to perfection the contemporary techniques and skills associated with the operation of the on-board equipment that enables the medical research in space. He participated in the testing of the systems for the Soyuz craft and the Salyut orbital station and in the work of the search-and-rescue service, and he was an experimentor and advisor in the many experiments simulating space flight factors. As a shift supervisor of the Flight Control Center's medical group, Valeriy got to know all the fine points associated with the support of space missions.

The scientific work was combined with training at the Cosmonaut Training Center imeni Yu. A. Gagarin. Indeed, he has been part of the cosmonaut corps since 1972, and he began preparing for a flight as a physician-researcher on the Soyuz-T craft and the Salyut orbital station in 1979.

The years went by. The space equipment was improved. New craft went into space, and the length of time man stayed aboard the orbital stations became longer. Now there was just a little further to go to the cherished limit—a year-long space flight. Not all the physicians who began training together with Valeriy Polyakov in the cosmonaut corps passed the difficult tests. Some left because of health reasons, others resigned because they did not see any prospects for a flight in the near future. Indeed, there were years and years of study, intensive training, tests, examinations, and new training. And all of that required the ability to endure, to wait, to believe. One needed a great deal of courage, efficiency, and willpower. Only all that taken together could ultimately yield the desired results.

And then came 1988, a fortunate year for Valeriy Polyakov. In February, he was included in the group that began preparing for the international Soviet-Afghan flight. In early August, the State Commission approved the make-up of the crews. The main crew consisted of Vladimir Lyakhov, Abdul Akhad Momand, and Valeriy Polyakov. And on 29 August, at 0823 hours Moscow time, Valeriy Polyakov's time to shine arrived. The dream he had been pursuing for so many years had come true.

The Crews' 'Resident' Doctor

As a physician, Polyakov was "out of luck": the Soyuz-TM-6's crew felt fine during the critical period of adaptation to weightlessness, and no one had any discomfort. Over the course of the two days before the ship's docking with the Mir complex, they worked amicably, in good spirits. Valeriy joked: "I thought, What am I supposed to do when everything is going without a hitch? Is it possible I'll have no luck with the crew? I didn't slack off."

But then came the docking with Mir, where Vladimir Titov and Musa Manarov, who were about to set a new world's record for a stay in space, were waiting for them. Polyakov the physician, who had just arrived in orbit, was supposed to directly monitor the state of health of the future record holders. While conducting the medical exam, he transmitted this to the ground: "I have examined the fellows and measured the parameters. The crew's condition is good, and their efficiency is in tip-top shape. There are no contraindications with respect to the work that is planned. Everything is in order, and there are no problems."

And so the work began: the experiments, the astrophysical and geophysical observations, the unloading of the space "freighters," the repair and preventive maintenance operations, the physical exercise, and the communications sessions with the Flight Control Center. After completing the program, the Protony [call sign, Protons]—V. Lyakhov and A. Momand—returned to Earth. Proton-2—V. Polyakov—remained on board Mir, changing his call sign to Okean-3 [Ocean-3]. And, on 28 November, at the doorstep of the space home, they greeted the Donbassy [Donbasses]—Aleksandr Volkov, Sergey Krikalev and Jean-Luc Chretien. And, again, an intensive three-week program ensued. Polyakov reported this to Earth: "Everything is proceeding routinely, we are spinning around and revolving. We are doing our best to get everything done—that's how the work is. Everything is in order, and we have nothing to complain about. We are making heroic efforts to complete the daily program." Later he confessed: "Work in space is hard labor. Very hard. I can tell you that without

exaggeration, having seen and experienced for myself how the fellows manage here, in orbit."

Everyone really worked up a sweat during the spacewalk by Aleksandr Volkov and Jean-Luc Chretien on 9 December 1988, when they conducted the Era experiment involving the hinged truss structure and set up the panels for recording meteors. While performing that work, the cosmonauts demonstrated not only a high level of professional skill, but also resourcefulness and keen wits. They were in open space for six hours—the longest sojourn outside a spacecraft ever recorded in the Soviet Union.

During one communications session, one of the correspondents, addressing Valeriy Polyakov, asked this: "You are now the crew's 'resident' doctor.... What have you done in that capacity during the flight?" Came the response: "Even before the flight, I said that a doctor should be paid not for the number of sick people he's cured, but rather for the fact that no one's gotten sick. Right now the fellows are paying me with their kindness and love for the fact that they and I are still healthy." "But have you been able to do some scientific work?" "Yes, of course. First of all, there was the very interesting program put together by the Biomedical Problems Institute in cooperation with other organizations. And there have been my own good projects, which are now in the process of being carried out."

However, for the time being, the physician-researcher's primary tasks remained the monitoring of the crew members' state of health and the prediction of their efficiency on the long-duration flight. He had to prepare the long-term space residents, V. Titov and M. Manarov, for the return to Earth, and for that, there were tested systems aboard the station—the athletic training equipment and the Pingvin and Chibis suits.

On 21 December, the Okeany left the Mir station. Whereupon Valeriy Polyakov changed his call sign yet another time, swapping his for Jean-Luc Chretien's. Now Polyakov was Donbass-3. On that same day, the space flight of V. Titov and M. Manarov, which was the longest in the history of cosmonautics and which lasted 365 days 22 hours 38 minutes and 57 seconds—one year—drew to a close.

Birthday Gifts

After the departure of the Okeany, Polyakov the physician had fewer patients left, but, on the other hand, Polyakov the researcher had a lot more time. Although, even prior to that, he had managed to do quite a bit.

As we know, in weightlessness, the blood rushes to the upper part of the body, into the cerebral vessels. At Valeriy's suggestion, he tested the Braslet elastic thigh cuffs during the mission on the Mir station. When they were put on, they kept blood in the lower extremities, and blood circulation normalized, as it were, and the cosmonaut felt better.

The effect of weightlessness on the cosmonauts' cardiovascular systems was investigated with the state-of-the-art Ekhograf-2 system, developed by French specialists. The system made it possible to follow in detail the special features of the movement of blood. Ultrasound and Doppler methods were used to evaluate the speed and nature of the blood flow in the vessels and the internal organs. In addition, an evaluation was made of the change in the heart's pumping and contracting functions.

In order to better understand how the metabolic processes proceed in orbit, V. Polyakov conducted the Minilab experiment, which involved drawing blood from a vein. The hormonal regulation of the water-salt metabolism of a person's body at various stages of a space flight was studied, as was the interrelationship between the circulatory system's condition and the water-salt metabolism. An experiment was performed with the Czechoslovakian Plazma-02 system, intended for the collection, processing, storage, and transport of the collected material to Earth. Based on the experiments' results, new equipment and recommendations are being developed to facilitate a person's adaptation to space flight conditions.

Polyakov also participated in the French Fizali experiment. The mechanism of the interaction of a person's sensory and motor systems was studied, which will make it possible to determine the possibilities of operator activity in weightlessness. In the experiment, special equipment recorded the bioelectric activity of the oculomotor muscles. Those data are necessary in order to gain an understanding of the mechanism of motion sickness, which some cosmonauts experience during the initial period of adaptation to weightlessness.

Studied in the Viminal experiment were the psychophysiological characteristics of a cosmonaut's operator activity and the changes in them during the process of adaptation to weightlessness. Shown simultaneously to the test subject on a video monitor were images of two- and three-dimensional figures with complex geometric shapes in various orientations. Perfectly identical figures, one of which could be a mirror image of the other, could appear on the screen. The test subject had to determine what kinds of figures they were. The correctness of the response and the time it took to make a decision were used to evaluate the state of the visual and spatial perception system in weightlessness, as well as the effect of weightlessness on the state of the muscle memory and the features of the interaction of the visual and motor systems.

In order to test new physical stress conditions, Polyakov the physician used the special Fiziotest equipment with programmed control and automatic processing of the data from the functional tests. The optimal conditions for physical conditioning by the cosmonauts on a long-duration flight were determined in the Sport experiment.

The cosmonaut-researcher conducted hematological tests in all the crew members, including himself. He worked with the new Reflotron medical instrument, which makes it possible to conduct a large number of analyses of capillary blood. The compact apparatus makes it possible to determine the necessary parameters very quickly.

The research associates from the Biomedical Problems Institute gave high marks to the medical experiments that were performed. After all, it was unique for a doctor to be able to examine three crews at various stages of orbital flight. The effect of weightlessness on the body during the period of critical adaptation was studied in five cosmonauts. Two were observed by Polyakov in the final stage of the lengthy, year-long flight. Of special value here, of course, are his own perceptions, which were reinforced by the instrument readings.

The medical experiments were only part of the broad flight program. And each cosmonaut made his own contribution to the realization of all of its components. It must be remembered that the months in orbit, after all, still involve everyday living. Incidentally, more than anyone else, it was Valeriy Polyakov who prepared the food, displaying an innate inventiveness. As reported from on board, he devised a new dish—onion with lemon and bread. Even he himself spoke jokingly about the sojourn on the station: "This is a good rehab center. The food is nutritious and well-balanced. There's regular exercise. No bad habits—you don't smoke and you drink only tea and juices!".

But, back at home, it was already spring. April was coming to an end, the Donbassy's temporary duty aboard the Mir was drawing to a close, and the time had come for them, too, to don the Chibis suits. More and more frequently in the communications sessions with the ground, the cosmonauts received advice about what to stow and where. Finally, the instruments were turned off, and the systems placed on stand-by. On the advice of the physicians, they drank of 100 grams of a salt solution for the road, put on the medical belts and the Karkas pants. The pants were made of a special material that expands on one side. Individually fitted, they tightly encompass the shins and thighs and thereby impede the redistribution of fluids into the lower half of the body when the g-forces arise during the craft's reentry. The hatches were battened down. It was time to cast off.

The reentry proceeded exactly according to plan. On 27 April, the Donbassy returned to Earth. But the cosmonauts were congratulated not merely for their safe return. Valeriy Polyakov had turned 47 that day. But he took care of the gifts himself. They consisted of his new knowledge of man and space, which enabled him to toil far above the Earth for eight months and, before that, to make it through the years he spent persistently pursuing the goal he had set for himself.

Georgian Design Bureau Developing Deployable Structures for Orbital Telescopes

917Q0069 Tbilisi ZARYA VOSTOKA in Russian 8 Nov 1990 p 2

[Article from ZARYA VOSTOKA: "From the Aragvsk Valley to...Space, or Some Uncelebrated Aspects of the Activity of Georgian Engineers and Researchers That Couldn't Be Written About Before"]

[Text] For the information of those who may consider those words a journalistic trick to get the reader interested, let us say right now that although no one transferred the Baykonur cosmodrome to the vicinity of Mtskheta, there is, in fact, no exaggeration in our headline.

Do you recall what happened in space orbit on 5 March of last year, when the decision was made to deploy a large structure in space on the cargo craft Progress-40? The experiment was performed at precisely the designated time. When the results of the experiment were being tallied, gratitude was expressed to the collective of individuals responsible for the success of the experiment. Named among the individuals was a special design bureau of the Georgian Technical University. Shortly thereafter, the administration of that institute of higher learning received a letter from the general designer, who thanked the bureau's collective for their fruitful contribution to the whole matter.

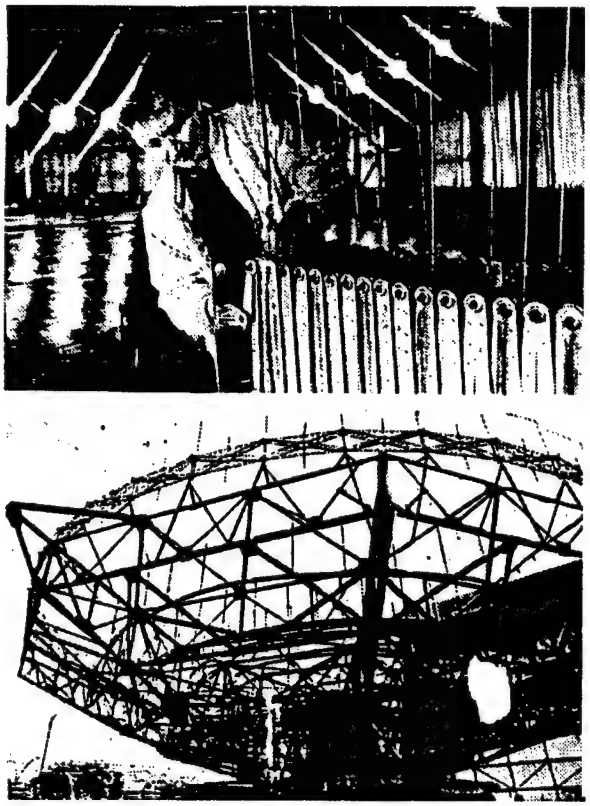
The young collective of the bureau was created in 1981 on the initiative of its present director and chief designer, Elgudzha Medzmariashvili, who heads the department of structural designs at the technical university. He founded the group on the basis of a student design bureau which had been formed two years earlier.

A complete cycle of theoretical and experimental studies has already been performed, and these studies served as the basis for the creation of the first designs for radio telescopes on Earth and in space which meet world standards.

'Buran-2' Shuttle Moved to Launchpad at Baykonur

PM1705115791 Moscow Central Television First Program Network in Russian 1800 GMT 15 May 91

[Report by A. Gerasimov, P. Orlov, and V. Pankratov from Baykonur; from the "Vremya" newscast]



Upper left, a telescope that unfolds in space, in closed position here on a stand for precision, or extremely precise, assembly of large structures; lower left, the testing of the unfolding space radio telescope on a weightlessness-simulation stand; right, the director and chief designer of the special design bureau of the Georgian Technical University, Elgudzha Medzmariashvili, who heads the department of structural designs, at one of the stands. Photos by Anatoliy Ruzhadze (Photo narrative by the Information Agency of Sakartvelo).

[Text] [Announcer] The new Buran-2 reusable spacecraft has been moved from the assembly and test hall to the Baykonur launchpad.

[Unidentified voice] This craft will dock with the Mir station, and the Buran crew will board it in orbit. For the time being, the reusable spacecraft is ready for ground tests only.

On the morning when the Buran was being wheeled on a mockup carrier rocket toward the launch pad, the crews of the upcoming Soviet-British space expedition were receiving their Soyuz TM-12 craft in the neighboring assembly and test hall and packing a shipment to themselves—the Progress cargo craft.

Judging by appearances, the sight of the resuable spacecraft on the launchpad made a profound impression, on the British cosmonauts in particular. For our cosmonauts it spells a different kind of future. But the next two space expeditions—Artsebarskiy and Krikalev, and after them their backup crew of Volkov and Kaleri—will not be working on the Buran. They are undergoing training for normal Soyuz launches.

On the eve of the launch both crews were given the go-ahead by medics for the upcoming flight. For the Soviet cosmonauts this means eight extravehicular activities and five months of work in orbit.

According to what we were told, however, funds for the space program are guaranteed only for the next quarter. Right now we are having to choose between fundamental and applied experiments. The number of astrophysical observations on the current expedition has been substantially cut back.

It is hoped that next year, which has been declared Space Year, this craft will carry a Mir crew.

'Informkosmos' Director Discusses 'Ekspress' Communications Satellite Project

917Q0043 Moscow KRASNAYA ZVEZDA in Russian 15 Dec 90 p 6

[Interview with Viktor Petrovich Afonov, general executive director of the Informkosmos Association, by M. Rebrov: "Commercial Space"; first two paragraphs are source introduction; last two paragraphs constitute epilogue and boxed item]

[Text] **A paraphrase of the well-known saying might go like this: "A telephone is not a luxury, it's a grim necessity." Idle statisticians have calculated that, every day, Americans make more than a billion calls. At any time and in practically any spot in the United States, it is asserted in advertising brochures, you can pick the receiver and connect almost instantaneously with any of the 215 million customers in the United States or with any of the many millions of customers in other countries. In fact, the advertising reflects the true state of affairs.**

Today, everyone needs communications. It reduces distances, compresses time, and expands contacts between knowledge and people. Our successes in providing telephone service are, dismal as it is, quite modest. In that area, we are lagging behind the developed countries by 10 or even 15 years. According to Ministry of Communications estimates, solving the problem with traditional methods will require astronomical expenditures—60 billion rubles. But what do the alternative versions promise? I began my conversation with the general executive director of the Informkosmos Association with that question.

[Afonov] For the land area of the USSR, which spans 12 time zones from east to west and stretches from 35°N latitude almost to the North Pole, only space-based communications can be uniquely efficient. Operating at present is the national economic system that uses the Gorizont satellites. Created more than 10 years ago, it cannot satisfy today's ever growing needs for communications systems. Its capabilities are limited: 3,200 telephone channels in all. Analyses indicate that, at this very moment, the country's national economy needs at least 40,000-50,000 such channels. Who will be able to solve the problem of providing telephone service, and when?

[Rebrov] An answer suggests itself immediately: the Ministry of Communications. Doesn't that make sense?

[Afonov] It does. But it's not as simple as it seems at times. That is why the commercial association Informkosmos is setting out to fill the gap in satellite communications systems. It is ready to consolidate the efforts of many organizations belonging not to a single ministry, but rather to several ministries and to take the trouble to design the new, promising Ekspress [Express] satellite communications system and to begin its operation.

[Rebrov] And just who is included in your association?

[Afonov] It was founded by organizations that have been at the wellspring of the development of communications satellites. They include the NPO [Scientific Production Association] Radio, which has been developing communications equipment for more than 30 years; the Applied Mechanics NPO; the Space Instrument Building NPO, and a space communication production association.

[Rebrov] What is the Ekspress system?

[Afonov] First of all, it is a versatile system, and it will make enable multichannel telephone traffics by connecting nationwide and area communications centers within the country. Provisions have also been made for an outlet to the international networks. Ekspress will provide telephone communications and will enable telegraph transmission, high-speed computer-data traffic, and the transmission of television programs. The new system will connect both people and machines with one another.

[Rebrov] But what are its qualitative characteristics and, in particular, how is the reliability?

[Afonov] Reliability promises to be high. Provisions have also been made for various service features. Ekspress will facilitate the use of communications and will offer customers dedicated channels, the possibility of establishing autonomous departmental networks, and so on. I should mention the simplicity and relatively low cost of the ground transceiving stations, which are equipped with the proper channel-generating equipment.

Let me add this. The Ekspress system was developed on the basis of engineering and technological designs that were tested on domestic space communications vehicles that make use of the latest achievements in the fields of electronics, radio engineering and communications. As a result of that, the active life of the Ekspress satellites has been extended, the number of duplex telephone channels has grown, and the stabilization system has been improved. The cost of the ground stations has been reduced threefold. If you consider that the national economy needs thousands such stations, the overall gain is obvious.

[Rebrov] And so, the number of communications channels will increase, and a space-based automatic telephone exchange will make it possible to solve the many problems associated with providing ground telephone service. But what new conveniences does the communications system of tomorrow promise us?

[Afonov] In the film "Back to the Future," there is one scene in which one of the characters places a call on a videophone. The face of the caller appears on a large screen, and a printer that is right next to the screen immediately prints out information about that person, giving his first name, last name, age, profession, the nature of his political views, hobbies—

[Rebrov] But aren't those just scenes from a science fiction film, not to mention one that's intended for undemanding viewers?

[Afonov] I'm not talking about the film as such, but about the equipment. Today, a telephone that enables you to determine, without lifting up the receiver, who is calling you and that even provides detailed information about the personality of the person who has dialed your number is not merely the fruit of an idle imagination.

[Rebrov] But let's get back to Informkosmos and its projects. How much will the planned system cost the association?

[Afonov] Several hundred million rubles. However, after it begins operating in 1993, we expect to recover our expenses within two and a half-three years. Moreover, Ekspress will bring Informkosmos an annual profit. And a fairly good-sized one. Which will go to further improvement of communications systems.

[Rebrov] All that is very alluring, but the Ministry of Communications could also solve the problem of providing telephone service (not to mention other problems), could make our lives easier, and, at the same time, could derive a profit for itself.

[Afonov] I must reiterate that not all organizations are subordinate to this ministry. Hence the difficulties—financial and organizational.

[Rebrov] Who will put your satellites into orbit?

[Afonov] The Ministry of Defense. Naturally, we will pay for the launch vehicles and launch support.

[Epilogue]

I listened to Viktor Petrovich and reflected: life demands new creative solutions that are well thought-out and calculated. And practically the first thing that has to be reckoned with is that time is money. Both time and money can be wasted, or used well. Today, time is THE main thing we're short of—it rushes by and demands action. Space should have been commercialized long ago. That is also what the discussion was about in the USSR Supreme Soviet.

[Boxed item] Get to know the new association. The energy and the experience of the "Four Giants." What the orbital automatic telephone exchanges promise.

Soviet Participation in 'FIFE-1989' Remote Sensing Study

917Q0060 Moscow PRIRODA in Russian No 12, Dec 90 pp 60-65

[Article by A. M. Grin, doctor of geographical sciences, Laboratory of Experimental Studies of Geosystems and the Institute of Geography, USSR Academy of Sciences, and V. V. Kozoderov, doctor of physical and mathematical sciences and lead scientific associate, Department of Computational Mathematics, USSR Academy of Sciences: "'Subsatellite' Experiments"]

[Text] In the summer of 1989, a group of Soviet specialists participated in the FIFE-1989 field experiment (First ISLSCP Field Experiment, in the International Satellite Land Surface Climatology Project) that took place in Kansas (mainly in the Konza [as published] reservation). Their objective was to obtain data for the interpretation of satellite observations of the condition of the land surface. We will talk about the results of that work, but first, a short trip into the past.

The development of techniques for remote sensing of the Earth's geosystems, and of means of using the resultant data in models for evaluating the condition of those systems, has a history that is short but full of events. Even the first successful surveys of Earth from space from special satellites and manned spacecraft of the USSR and the United States—and, later, of other countries—provided a vast amount of information. But if the means of evaluating static objects on the Earth's surface (geological formations, hydrographic networks, the boundaries of natural zones, or transportation networks) from space images is rather simple and has been mastered, the study of relatively rapidly-changing processes and phenomena on Earth has required the development of special, complex means of deciphering those materials, means that do not always provide unambiguous answers. When the object of investigation is, for example, an extremely complex, changing formation—such as the global climate system and its dependence on the state of the geosystems of the land surface—the difficulties are especially great.

Specialists in atmospheric physics were the first to begin using satellite data in global forcasting models. They were followed by designers of climate models that enabled evaluation of the effects of concentrations of carbon dioxide and other gaseous trace components on the environment. It was found that changes in the nature of the land surface—especially hydrometeorological parameters that control the development of vegetation—have a substantial effect on the global climate system. To study the contribution of those biogeophysical processes to the features of the functioning of such a system, researchers needed mathematical models that would correctly describe the state of the biosphere and would identify the critical parameters and "key points" of the system that have the greatest effect on climate change. Correct models require correct data, or more precisely, data banks, and measurement and computation systems. It became clear that prediction of changes in climate and in man's habitat would hardly be possible without international coordination and cooperation of work done on a global scale.

In 1983, the Committee for Studies of Space and the International Association of Meteorology and Atmospheric Physics came forward with an initiative to implement the International Satellite Land Surface Climatology Project. In the iniative, they expressed the desire

that specialists of more than 30 countries, including the USSR (beginning in 1985), take part in the project.

It was in the framework of that project that the first field experiment was conducted, on a portion of the Kansas prairie. The experiment, FIFE-1987, studied processes in the atmosphere and on the Earth's surface via ground-based, aerial (helicopters and airplanes), and space-based observations. We did not come empty-handed to the FIFE experiment in 1989; we already had experience in the so-called subsatellite experiments of Kursk-85 and Kureks-88, which were conducted in the Soviet Union and were also of an international nature.

In the first experiment, Kursk-85 (which, in essence, was the first attempt to conduct international studies of the same object and at the same time, but at different altitudes), more than 50 specialists from various countries participated. The aim was to develop methods of interpreting remote sensing materials to evaluate the dynamic states of land geosystems. In test sectors of the Kursk Aerospace Test Range, synchronous (or quasi-synchronous) ground-based observations were made of the state of the complex of biogeophysical parameters at the moment the Earth's surface was imaged by their remote sensing equipment in all ranges of the spectrum. The "altitude stacking" principle was used here, in which the imaging—in the same spectral regions, when possible—is done from altitudes of several meters above the surface to near space. That makes it possible to later use sequential approximations to solve the problem of interpreting aerospace information.

During the Kureks-88 experiment, attention was focused on evaluation of the variability in biogeophysical parameters on the landscape ("grid") level within the "cells" of a large climate model 200 km long and 100 km wide. Those dimensions corresponded completely with the Kursk model region, which had been studied for many years by the Institute of Geography of the USSR Academy of Sciences—the Seym River basin to the town of Rylsk. The experiment was conducted from November 1987 to November 1988 (during the hydrological year) and had an "active phase" from 10 June to 10 July 1988. During that time, scientists from many countries of Europe, from China, and from Cuba worked at the site, measuring fluxes of heat and moisture in the surface layer of air and in the upper layers of soil and ascertaining the state of the vegetation and the dynamics for its development, the flow of the rivers and the level of ground water, and the hydrophysical parameters of the ground cover and their variability over area. Images were made from aerial platforms, small radio-controlled model airplanes, helicopters, airplanes, and spacecraft, including the Mir manned complex. Identification of the relationships between processes of atmospheric circulation and biogeophysical properties on the grid level refined climatic models substantially. NASA specialists and organizers of similar experiments in the United States—FIFE-1987 and FIFE 1989—visited the site as observers.

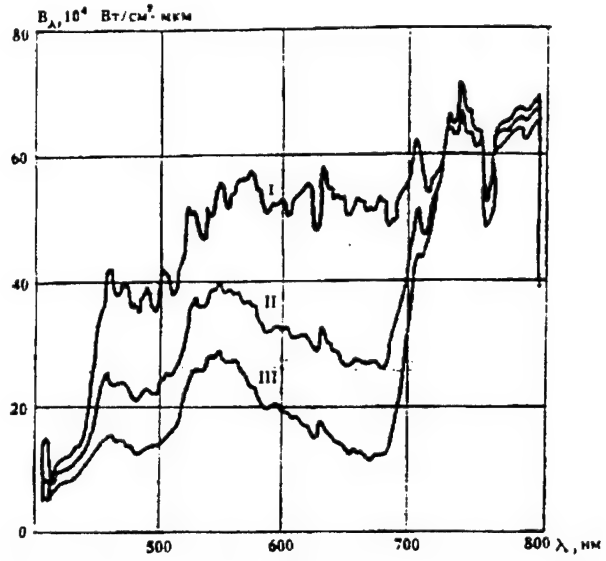
About 150 individuals of various specialties participated in the FIFE-1987 experiment. Information from four satellites was used—the geostationary GEOS, the polar-orbiting NOAA and Landsat (U.S.) and SPOT (France)—as well as six different types of airplanes and helicopters. The test sector near Manhattan (Kansas) was 15 x 15 km. Measurements were made of the radiation, atmospheric, and biophysical parameters. The test range consisted mainly of sectors of low and high prairie vegetation typical of the Midwest. Continuous monitoring of the state of the geosystems at the Konza reservation during 1987 was combined with four intense field campaigns that lasteda total of 57 days and in which individuals from various specialties participated in ground-based and near-surface measurements of a chosen test sector.

The FIFE 1989 experiment was on a similar scale. The Soviet "science team" that participated in it consisted of nine people. Overall, our program had a clear "satellite emphasis," whose aim was to determine the systematic possibilities of recovering soil and vegetation parameters (phytomass, moisture, temperature, vegetation indices, etc) from the data of the Soviet Kosmos-1939 satellite. The satellite had high- and medium-resolution (50-150 m) scanning equipment. A comparison was made between those data and the data of Landsat and SPOT.

One direction taken by the study involved ground-based and aerial (from a helicopter) measurements of the transparency of the atmosphere. On the ground, this was done with a manual measurement device intended to estimate during the daytime the transparency of the atmosphere in nine regions of the spectrum: 420 nm, 440 nm, 510 nm, 550 nm, 580 nm, 650 nm, 750 nm, 930 nm, and 1020 nm. The device is a spectrophotometer with interference filters, and it directly measures direct solar radiation. The transparency itself is determined by comparing the measured value with the corresponding value in the upper part of the atmosphere.

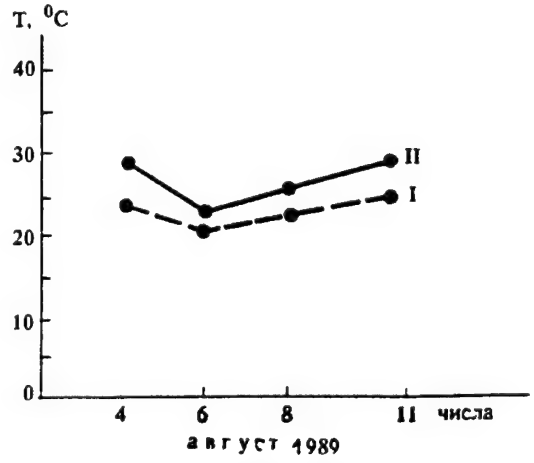
The Gemma spectrometric system, which was manufactured at Belorussian State University, was used to make images from a helicopter hovering above the region of the site under study or flying along a certain path (the altitude for all the measurements was the same, about 300 m; measurements were made during cloudless weather only).

Two thousand spectra were obtained from images made over a period of eight days in August. Those spectra made it possible to obtain average statistical values of the distribution of spectral density of radiance for three sectors of the test range in identical illumination conditions: for a typical American prairie (point No. 916), a forest region (point No. 999), and bare soil and dry prairie vegetation (point No. 926). The spectral "images" of those regions were generally typical for the entire test range.



Average values of spectral brightness of various geosystems on test sector: typical American prairie (I), forest (II), and bare soil with areas of dry vegetation (III).
x- axis: λ, nm; *y*-axis, $Wave_\lambda$, 10^4 W/cm^2 x μm.

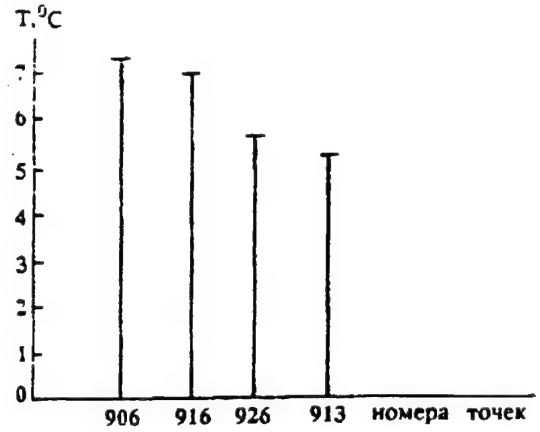
The surface temperature was measured with a Mara infrared radiometer from the Institute of Geography of the USSR Academy of Sciences. The radiometer was installed on a helicopter. The measurements were also made at 300 m. The values were recorded on a magnetic medium and later processed on a personal computer.



Surface radiation temperatures of the prairie (I) and forest (II) measured by the Mara radiometer during the experiment, August 1989.
x-axis, date

The objects of investigation were primarily the American prairies, and only two of the objects studied were deciduous forest with large meadows. The scatter of surface temperatures depended on the projected vegetative ground cover and the moisture of the soil. The goal of the experiment was to make special observations at the end of the vegetation period, when the prairie is completely burnt and the surface energy balance, albedo, surface temperature, flux of CO_2, and soil moisture vary substantially. The data are necessary to reduce the critical biological processes and states observed during the transition from moist to dry conditions. In conditions that are typical of a test sector with a moderate continental climate, the die-out of vegetation begins, according to average multi-year phenological observations, on 6 August. The experiment was confined to that very period. However, in 1989 the vegetation lasted longer, and the sharp change in biophysical indicators was not seen.

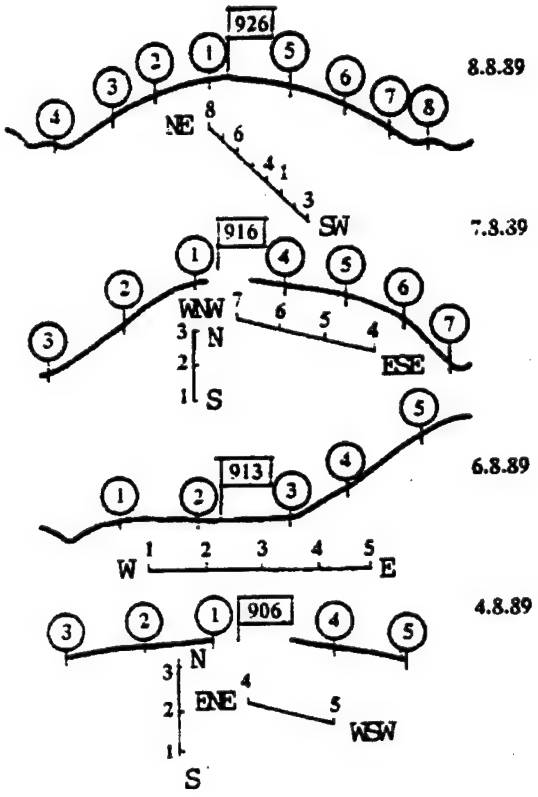
All of the observations were mainly made at three "points" (superpoints, in the terminology of our American colleagues): No. 906 (ungrazed prairie not yet burnt out), No. 916 (ungrazed, but burnt out) and No. 926 (grazed and burnt out). That made it possible, first, to obtain synchronous and comparable measurements and, second, to minimize disturbance of the soil and vegetative cover in the reservation territory. We chose yet another supplemental point, No. 913, which best matched, in our opinion, the conditions of the reserved, unmowed steppe in the Kursk region.



Average radiation temperatures at main observation points.
x-axis, point number

Ground-based phytometric work was done in such a way that it characterized as completely as possible the vegetative cover and produced correlation dependences between the remotely obtained spectral characteristics of the plants and soil and their parameters determined in ground-based experiments. In each of the indicated "points" of the test range, a line was drawn (a transect) intersecting the watershed, the slopes of various exposures, and the floors of gullies. The average height of ground cover and its projected canopy was measured at points on the transect. The above-ground phytomass was determined, and mowed vegetation was divided into living (green) and dead (burnt). The percentage of moisture content was also calculated. To identify the dynamics of the correlation of living and dead vegetative mass as it became burnt out by the sun, repeat observations were made on three transects. But even in the last

period of observation, 8 August, the percentage of green vegetative mass at the main points was still relatively high. It was not possible to determine the decline in the so-called leaf index—the total area of leaves in one square kilometer. Overall, the scatter of the average values of the phytomass and leaf index on the transect (which, as it were, characterizes one "point" on the test range) was very large (as high as 200 percent). The lowest values for both parameters, as a rule, characterized watersheds; as one approached the floors of gullies, both the phytomass and the leaf index increased. Both indicators depend on the usage of the territory—in regions burnt to varying extents, natural ground litter is virtually absent, and the percentage of dead phytomass is substantially lower.



Transects and locations (numbers in circles) of measurements of water reserves in the soil and of the biomass of grassy vegetation.

All of the phytometric observations were made in accordance with the program of measurements of soil moisture, and that synchronicity should reveal the patterns of their associated change.

The water in the upper layers (0-2 cm) of soil was measured with the traditional thermostat-gravimetric method, and in the layers (10-50 cm), with a neutron moisture meter was used. The Americans determined moisture in the 0-5 cm layer from the variation in electrical conductivity, and down to 50 cm, with a device that is similar to the Soviet device, although ours is equipped with only a gamma pulse counter, while the American model uses a minicomputer compatible with a personal computer. To our great mutual satisfaction, the scatter of values measured by the Soviet and American devices were relatively small and, with the rare exception, completely corresponded to the accepted standards of accuracy.

However, if our American colleagues, in estimating soil moisture at a "point" of observation, limited themselves to measurement of the upper part of the watershed, where a complex set of equipment was installed to measure characteristics of the surface layer of air, our measurements were made in five-seven boreholes on transects intersecting the main forms of relief. The deviation in moisture values measured in various holes along a transect through one "point" substantially exceeded the differences in the average reserves of water at the "points." Therefore, we feel that our average values of soil moisture better characterize the specific type of surface and are more appropriate for a comparison of observational data with remote sensing data.

The data obtained in the FIFE-1989 experiment make it possible to approximate a reliable estimate of the state of the Earth's surface from remote sensing data, which is quite significant in the organization of space monitoring. In the ever worsening ecological conditions, this task is becoming ever more important.

All of the initial information on the measurement programs of the United States, USSR, Canada, Great Britain, and France is now stored at Goddard Space Flight Center. The participants in the experiment have begun to process it, constantly interacting with each other. In the fall of 1990, a scientific conference on the findings of the FIFE-1987 and FIFE-1989 experiments will be held. A program is being formulated for the Kursk-91 experiment, in which specialists from other countries, including the United States, with their measurement devices, will participate with Soviet specialists. Ahead are new international comprehensive experiments in the Sahel region of Africa, at the edges of the boreal forests and tundra in Canada, and in the desert regions of the USSR.

'Almaz' To Conduct Radar Surveys

PM0404131591 Moscow Central Television First Program Network in Russian 1800 GMT 1 Apr 91

[Report by Petr Orlov, from the "Vremya" newscast]

[Text] [Orlov] After years of silence, the Almaz orbital station has been officially entered in the Soviet space research program.

The station was launched by a "Proton" rocket in automatic mode. The predecessors of this Almaz orbital station, which was built at the Chelomey Design Bureau, were placed in orbit many years ago under "Cosmos"

and "Salyut" codenames. Some of them were even manned. Now this program has been revived with new objectives. It has been announced that (?radar) surveys of our country and other countries in the interests of geology, compilation of accurate maps, study of the oceans, ecology, and agriculture are to be carried out from the Almaz-1 station.

It is planned to create an entire aerospace system on the basis of the Almaz station to study the earth's resources and to complement the scientific programs carried out on the manned Mir station which is in a different orbit.

Three Glonass Satellites Launched 4 Apr

LD0804081791 Moscow TASS International Service in Russian 0749 GMT 8 Apr 91

[Text] Moscow, 8 Apr (TASS)—Here is an announcement about the launch of three satellites which was released here today.

Three artificial earth satellites, Cosmos-2139, Cosmos-2140, and Cosmos-2141 were launched aboard a Proton booster rocket on 4 April 1991 in the Soviet Union. The purpose of the satellites is to continue testing components and equipment for the "Glonass" global space navigation system, which is being established in order to determine the location of Soviet civil aircraft, ocean-going ships, and fishing vessels.

The satellites have been put into a near-circular orbit with the following parameters:
—initial period of revolution—11 hours 16 minutes;
—distance from the surface of the Earth—19,148 km;
—inclination of orbit—64.8 degrees.

The equipment on board the satellites is working normally. The coordinating and computing center is processing the incoming information.

'Meteor-3' Satellite Launched 24 Apr

LD2404153491 Moscow TASS in English 1510 GMT 24 Apr 91

[Text] Moscow April 24 TASS—The Soviet Union today launched a weather service satellite, Meteor-3, to upgrade the country's meteorological system using space probes.

The mission aims to try out test and information instruments and remote sensing methods that will be employed to study the atmosphere and earth in the interest of the national economy and science.

A Tsiklon rocket delivered Meteor-3 to an orbit with the following parameters:
Initial period of revolution—109.5 minutes,
Maximum, distance from earth—1,229 kilometers,
Minimum distance—1,190 km,
Inclination—82.6 degrees.

The satellite's equipment is functioning normally.

'Resurs-F' Satellite Launched 21 May

LD2205114191 Moscow TASS International Service in Russian 1031 GMT 22 May 91

[Text] Moscow, 22 May (TASS)—A regular artificial earth satellite, 'Resurs-F', was launched in the USSR on Tuesday [21 May] by a 'Soyuz' carrier rocket. It is designed to carry out widescale, multi-zonal, and spectrozonal photography, with the purpose of continuing research into the earth's natural resources in the interests of various branches of the USSR national economy and solving tasks of ecology and international cooperation.

The satellite has been placed in an orbit with the following parameters: Initial period of revolution—88.8 minutes; apogee—274 km; perigee—194 km; orbital inclination 82.3 degrees.

The apparatus aboard the satellite is working normally.

'Okean' Satellite Launched 4 Jun

PM0606105791 Moscow IZVESTIYA in Russian 6 Jun 91 Union Edition p 1

[TASS report: "'Okean' Launched"]

[Text] An "Okean" satellite was launched from the Soviet Union by a "Tsiklon" launcher on 4 June 1991.

The main mission of the launch is to obtain prompt oceanographic information and data on the ice situation in the interests of various Soviet national economic sectors and international cooperation.

The satellite has been placed in orbit with the following parameters: maximum distance from the earth's surface (apogee), 679 km; minimum distance from the earth's surface (perigee), 652 km; orbital inclination, 82.5 degrees; initial orbital period, 97.8 minutes.

Complexes of scanning, optical, mechanical, and radiophysical equipment are installed on the satellite.

Information will be received from the satellite at the State Scientific Research Center for the Study of Natural Resources and at autonomous data receiving centers of the USSR State Committee for Hydrometeorology for processing and dissemination.

Yu. A. Mozzhorin, Director of TsNIIMash

917Q0064A Moscow ZEMLYA I VSELENNAYA in Russian No 6, Nov-Dec 90 p 30-31

[Article by now deceased A. A. Maksimov, hero of socialist labor, about Yuriy Aleksandrovich Mozzhorin, under the rubric "People of Science": "A Veteran of the Space Program"]

[Text] Time is marching on. The pioneers of space whose intellect, will and energy developed the country's space potential are dying off. That's why it is especially pleasant to pay homage to those who are still laboring at their posts, who continue the work begun in 1946 by Sergey Pavlovich Korolev and his associates.

It is from that galaxy that Yuriy Aleksandrovich Mozzhorin comes. Mozzhorin is the director of the Central Scientific Research Institute of Machine Building [TsNIIMash] of the Ministry of General Machine Building; he is a hero of socialist labor, recipient of the Lenin and State prizes, lieutenant general, doctor of technical sciences, and professor. On December 28, he will turn 70, and 44 of those years have been devoted to the development of rocket-space equipment.

After graduating from secondary school in 1938, Yuriy Aleksandrovich, a native Muscovite, entered the Moscow Aviation Institute. The war began, and, in June 1941, he was a private in a rifle regiment. He was later seriously wounded, in the August fighting around Vyazma, and he ended up in a hospital. In January 1942, Mozzhorin was sent to study at the Air Force Engineering Academy imeni N. Ye. Zhukovskiy. In June 1946, after graduating with distinction from the academy, Yuriy Aleksandrovich was sent to Germany on temporary duty as part of a special-assignment team to study the German long-range rockets.

After returning to Moscow in February 1947, he worked in the Main Artillery Directorate, specializing in the field of the ballistics and aeromechanics of long-range rockets. That was a completely new branch of science and technology. The flight of a rocket in the initial and final phases proceeds along a ballistic trajectory that is affected by the atmosphere aerodynamically; whereas, in the midcourse phase, the flight proceeds along an elliptical trajectory. Here the laws of celestial mechanics are in effect. But the main thing is that there is controlled, automatic flight in the boost phase. For a flight along such trajectories, a firing table has to be developed on the basis of control factors. There were no approaches, no methods developed for that—nothing. Everything had to be done from scratch. In the course of the work, new problems emerged. The rockets' range was always increasing, and the requirements for flight and strike accuracy were becoming more stringent, and to meet those requirements, one had to know and take into account more precisely the Earth's gravitational field, its heterogeneity, and other factors. All those matters had to be dealt with in earnest by the capable mathematician and aerodynamicist, Yu. A. Mozzhorin.

In November 1955, Yuriy Aleksandrovich Mozzhorin was appointed deputy chief of a military institute. Now he was confronted by the even more complicated problem of the theoretical elaboration and development of a control-and-telemetry complex for the first artificial Earth satellite.

The first thing that had to be done was to determine what kinds of measurements needed to be made on a flying satellite. The second thing that had to be done was to determine which of the extrinsic-to-trajectory measurements were needed primarily for operational processing and which were needed for complete processing. Their number was optimized, and the desired figure was compared against the capabilities of the hardware under development. Finally, the main thing—all the measurements made at the various sites within the vast territory of the USSR had to be gathered together and referenced to a common astronomical time. The entire measurement-gathering and -processing process also had to be synchronized and automated. Even more complicated was the matter of the telemetry measurements, which carried an enormous volume of information about the operation of the scientific systems and all the auxiliary systems, assemblies, and mechanisms of the launch vehicles and the space vehicles. The demands were endless, while the resources were limited, both technologically and economically.

After the specified initial data were ascertained and confirmed, orders had to be placed for the development of completely new measurement systems, both optical and electronic. And, finally, from all that, a single measurement complex had to be created. After the tracks for the insertion phase and the overflight had been laid out on the territory of the USSR, and after achieveable visibility zones for the newly developed measurement systems had been set up, the number of telemetry monitoring stations was optimized, based on the need to ensure a maximum observation time and the required measurement accuracy. The next important step was to choose the sites for the construction of those stations, taking into account their special geographic and economic features.

But that was not all. The measurement systems was supposed to be supplemented by target-in-space search equipment, automatic satellite flight tracking equipment, and equipment for preliminary and secondary processing of data collected at the sites and at the center. The magnitude of information flow had to be determined, and equipment for compressing and encoding the data being transmitted had to be developed.

Yuriy Aleksandrovich Mozzhorin became the chief ideologist and technical supervisor of the designing of that system, and, together with Georgiy Aleksandrovich Tyulin, he directed its practical realization.

The Lenin Prize was awarded to Yuriy Aleksandrovich Mozzhorin for the development of the first phase of the control-and-telemetry complex for the first artificial Earth satellite. For the development of the second phase of the control-and-telemetry system and the flight control center for the first manned craft, the Vostok, he was conferred the title of Hero of Socialist Labor.

In 1961, Yuriy Aleksandrovich was appointed director of TsNIIMash, which he has headed to the present day, for almost 30 years. In the new position, the volume of scientific problems to be solved expanded even more, as did Yuriy Aleksandrovich's range of interests.

TsNIIMash is the sector's head institute, the brain and ideological center where the development of rocket-space hardware as a whole and in individual areas is determined. What rocket-space hardware is needed? Which areas need to be developed first? Which of the systems proposed by the chief designers need to be developed, and which need to be refused? The answers to those questions and the recommendations that are made must be soundly based on and supported by a scientific and technical analysis of their efficiency and cost. All that is worked out here in TsNIIMash, under the supervision of Yu. A. Mozzhorin.

And that means that there are inevitable conflicts of differing opinions on the broadest range of questions and proposed tasks. Here there is not only a war of intellects, but also of temperaments. A war that requires courage and willpower and endurance. Yuriy Aleksandrovich has always had to be in the thick of that struggle. The role of arbitrator in the assessment of complicated problems has become for him almost routine. The military has its opinion and industry another, this needs to be done, but there is no money for it, and so on. Here also, for the sake of a cause, he has had to rub people the wrong way and has gone against the opinions of many authorities.

Yuriy Aleksandrovich, as chief developer of programs for the development of rocket-space hardware, of long-term plans, and of five-year plans when the appropriations have been extremely limited, has contributed substantially to ensuring the sector's leading position and the preeminence of domestic rocket-space hardware.

With expenditures substantially lower than those in the United States in comparable prices, the Soviet Union, based on labor remuneration factors, has developed a rocket-space sector, one of a few whose achievements and high level are recognized throughout the entire world.

If we shift from those "integral" problems to certain individual areas, then it is necessary to mention that, under the supervision of Yuriy Aleksandrovich, a system has been developed for quality control and reliability and a number of standards and basic documents have been worked out for regulating the procedure for the development and testing of rocket-space hardware.

The institute established and equipped the Soviet Flight Control Center for manned spacecraft and orbital complexes, as well as that for unmanned space vehicles intended for scientific and national economic purposes, with an overall capacity for the computer equipment of more than 100 million operations per second.

It is said that prominent leaders are ill-natured. In that regard, Yuriy Aleksandrovich Mozzhorin is pleasant exception. He is a very tactful, intelligent person. Always smiling, he asserts his point of view politely, authoritatively, and convincingly, doing so quite firmly, but without harsh attacks. He is able to listen to his opponents and to explain patiently his own position, never failing to respond to objections that are expressed. A person of exceptional modesty and a great efficiency, Yuriy Aleskandrovich devotes all his efforts and time to his beloved work.

General Designer Utkin Moves To New Post, Interviewed on Career

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[Article by Colonel M. Rebrov: "Profile of a General Designer: The Owl of Minerva Appears at Night"; first three paragraphs are KRASNAYA ZVEZDA introduction]

[Text] "Without the past, there is no present; without the present, there will be no future." That was said a long time ago, but not by me. This thought goes through our minds as we go through life. In this connection, a person often reflects on how little he knows about people who created and are now creating our rocket might. For both defense and space applications.

Today the names of the pioneers are well known: S. P. Korolev, V. P. Glushko, M. K. Yangel, N. A. Pilyugin; V. I. Kuznetsov; V. N. Chelomey, V. P. Makeyev. These and other chief designers and general designers did have and presently have students and disciples. Some of them may be nameless; if their name is mentioned, this is done so without reference to their occupation. Nonetheless, they do live and work. And their occupation is quite important. They exhibit strong feelings and put up a struggle in their jobs. I have had the opportunity on a number of occasions of meeting with one of them and holding open conversations, shedding light on that which for years was hidden behind a security label.

Academician Vladimir Fedorovich Utkin devoted almost 40 years to defense, creating many generations of missiles and space rockets. He was until recently the general director and general designer of the Yuzhnoye NPO [Scientific Production Association], which is located in Dnepropetrovsk. At the present time he is the head of a lead scientific research machinebuilding center

in Kaliningrad in the vicinity of Moscow. That is where his experiences of the past, present, and future come into play.

It occurred at Baykonur, in the beginning of October of last year. A launch of a Zenit was in progress. The order "Launch!" was given. The engines with their usual increasing noise were entering the booster phase. The timing operators started the countdown. All of a sudden a brief and bright flash split the sky, producing an enormous dark cloud.

The general designer listened to detailed reports: on the precise time of occurrence; behavior of the "item"; the damage caused to one of the launch pads.

"What about the people?" interrupted Utkin. "What about the people, I ask you?"

The Zenit's launch was fully automated; this kind of procedure is performed without human intervention." Present however in the area were testers, developmental engineers and representatives of science—about 100 persons in all.

"There were no human injuries."

This calmed him down somewhat, but did not do much to relieve the tension. Questions shot through his mind: Why? What went wrong? That certainly was not the first launch.

"A random occurrence, perhaps?" he asked.

I must admit that in my eagerness to get the full story, I tried to look into the eyes of Vladimir Fedorovich. He did not look away. But his face seemed to be pale. It seemed to me that something angered him, but maybe I am wrong. He said nothing for quite some time, then came right out with it:

"The trouble was a failure of the RD-170 first-stage engine; it was developed by another firm. I hesitate to blame them, with the technology so devilishly complex; the development of a new engine is a painful process."

He sighed, stood up, and went over to a window, through which I could see the rainy winter day drawing to an end. He did not long remain silent.

"I remember how the first secretary of the obkom gave me a magnifying glass as a gift on my birthday. It was quite ordinary—the kind you can find in any physics classroom. He explained to me the reason behind the gift: 'Take this, Vladimir Fedorovich. It is something you can use every day to look for dust particles on rockets.' That was not stretching the point too much. Our items consist of thousands of tiny parts, so that dust particles could actually cause something unpredictable. I am telling you this, because when something goes wrong, the blame falls on the general designer. That is the way it should be. However, if the general designer is held responsible for all successes and failures, then he should be listened to, and this is not always the case."

I could not help but ask him: "Have you ever been disappointed with yourself or suffered doubts about achieving a success or about your own abilities?"

"Well, ...," he said with a grin. He then fell into thought, as if the question meant something to him.

"I have suffered in the past and I suffer now. However, I must stress that I never became disappointed in our work. Also, a person can harbor doubts and still be successful. Yes! Yes! None other than Pascal said, 'Question theory, authority; test everything yourself, for even a silly thought can generate an excellent idea.'"

It took me some time to comprehend what he said. Sensing this, he continued:

"A random occurrence? But that is not a failure; it is the most important part of our work. Random occurrences are what dreams are made of. An unexpected occurrence, the way I look at it, is something new, something no one has yet encountered. Unexpected, interesting, important—these are synonyms, as it were. No two random occurrences are alike. What harms our work is amateurishness. I will not mention any names, since the fault lies more with stereotyped thinking."

Rockets. They determined his life for many years. The word has many shades of meaning the way he uses it. It does not sound militant, nor does it threaten or relegate everything else to a position of lesser importance. He endows the word with warmth, honesty, and humanity. I am convinced that his design work is inseparable from the ethical category, thus serving him in the capacity of a moral foundation. For the world is facing a multitude of new problems, without having resolved old ones, which show up here and there to deprive mankind of a tranquil existence. This is something we all must realize.

He was born in the Ryazan area. Mstera; Pustobor; Kasimov; Zabezhno [word indistinct], all located on the left bank of the Oka. Places of his father, grandparents, and great grandparents. Very beautiful there, deeply Russian, with a heavy aroma of bread baking, an aroma so thick that it could be nearly eaten. Kasimov with its churches and bell towers, factories, artisan shops, which sold their fishing nets to countries as far away as Japan. Their tanned sheepskin coats would be the envy of today's Hungarian craftsmen. There was more than this that brought fame to the "Rayki." Their cast iron, scythes, rafts, and barges were in use throughout Russia. The peasants of that area were self-willed and freedom-loving, endowed with wit and humor. If a merchant would lose an anchor that would later show up in the hands of the pilferer, the latter would spread his hands and say, "I spotted this anchor floating on the water and retrieved it." Vladimir Fedorovich told me about things like that.

Rockets. That is a word he never heard as a child. It started with a boy's games, whereby he and his brothers (there were four of them in the family) would make airplanes out of wood and paper and power them with a

rubber "motor" fashioned out of an old bicycle inner tube. That was the time of germination of the creative spirit that would later form a solid foundation for the rest of his life. The models flew, and not badly at that. That was not to last too long. Much time was not required to grow up. Boys his age became adults on the 22nd of June, 1941. Utkin already in August was one of them that arrived in Ulyanovsk to enroll in a military communications school. There were 10 times as many applicants as could be accepted. He found himself assigned to a reserve communications regiment; in May of 1942 he was sent to the Volkhov Front to serve in communications for the duration of the war.

He grew silent once more, thinking of the past.

"Memories of the war are something you retain for the rest of your life. Even half a century later, I still remember how I suffered a boy's fear: What if I never see the day of victory?"

He did see it! He returned to his native area, but there were no permanent jobs, not even small ones. The war swept away the captivating aroma of hot bread. In his pocket he had a biscuit, and that was moldy. Incompetent managers ran the foundry into the ground. What to do? Where to go? The first thought he had—to study engineering—he rejected. Not because he was not interested. Not at all! It was a time of hunger. "Maybe I should go into commerce. That is how people earn a good living." Before he could make a final decision, his older brother Nikolay intervened. After the father died, he took on the entire burden of caring for the younger children. "You must go to school," he said decidedly. "If you do not obtain an education, you will not get anywhere in life."

He was accepted into the Leningrad Military Mechanical School without the formality of entrance exams, since he had served at the front and had a good academic record. Although he had forgotten much during the war years, he had no problem keeping up with the other students. Study in the daytime; evenings, part-time jobs to earn money on which to live. As fate would have it, in Leningrad he got together with a friend from the front who was working in a phonograph record factory. That is where Vladimir and Aleksey Utkin (Aleksey Fedorovich, presently the chief designer of a defense design office, at that time also a student) acquired a hands-on knowledge of engineering.

The factory, not much in itself with its antiquated equipment, nonetheless was given directives from above: start producing more under the plan. This prompted the brothers to start modernizing the presses. Vladimir designed a 150-atmosphere hydraulic valve. It was put into service and successfully used. As a reward, he was given the first pressing with the inscription: "You have not changed."

Upon graduation from the higher educational institution (VUZ), he was sent to NII-4. He had a job but not a place to stay. His entire pay went to pay for the privately-owned apartment, actually part of a room. That is how he wound up in Dnepropetrovsk.

"I was fortunate to be there, as it turned out, even though it was hard at first. After suffering long ordeals, I was assigned a small dormitory room of eight meters for two families. Suddenly, luck! A room all to myself in a communal building! But the important thing was the interesting work. I gave it my full devotion, putting in 15 to 16 hours a day. When it was time to go home, the streetcars were no longer running. So I had to hoof it 10 kilometers. Home at two or three in the morning, back in the enterprise by nine am."

Utkin came into his own in Yuzhnoye, where his grasp of engineering was recognized. His skill in gaining people's interest and his organizational ability served to win his election to party committee secretary. Combining design and party work was not an easy matter. At that time (the year was 1954), the plant was about to produce missiles. M. K. Yangel, a Korolev man from Moscow, was appointed chief designer. Questions went through people's minds as they waited for him to arrive. What kind of man was he? Why are they sending a stranger? At that time, no one in Dnepropetrovsk knew Mikhail Kuzmich.

"At first we were making the R-1 rocket, which was patterned after the V-2. We called it 'item 8A11.' Then followed other Korolev developments: the R-2, R-5. We also created our own missiles, ones which used entirely different fuel components. They were given the SS designation: SS-4, SS-9, SS-5, SS-7. The SS-4 was employed as the base of the booster rocket that put the DS satellite—Dnepropetrovsk No 1—into orbit. It started the 'Cosmos' series."

After Yangel's death, Utkin took over the design office and plant collective. He did not believe in small tasks. The SS-18, SS-24, Tsiklon, and Zenit were only a part of what he accomplished, of what he achieved with much pain, to be more precise. He paid for it in sleepless nights and spats with persons who did not share his views. A chief designer's function goes beyond knowing how to work: He must also prove that he is right. Distrust of new ideas runs in the blood of people. There is no point to hiding the truth: In those years, some people were riding the crest of the wave, while others were working unnoticed by the "higher circles." But Uktin pursued his goals.

I watched him as he worked. He concentrates, somber and even rude in his ways. He becomes detached from everything. Telephone calls irritate him. He however cannot exist without communication. He agreed to take leave only on the condition that a radio-relay telephone be installed in his sanatorium room.

"A rest can do me good only if I am calm. I cannot stay away from work for any length of time. I simply cannot!"

That is the high drama of people like Utkin: At first they are able to control their energy, but later their energy takes them over.

Time. We often take notice of it when it is slipping away; implacable, relentless time. It goes away never to return. Never! It takes with it that which we have not finished doing, thinking through, or dreaming about. Vladimir Fedorovich reached for the telephone, but his hand stopped in mid-air. Assuming a look of frustration, he continued to speak:

"This has become a chronic illness, this lack of time. The day is not long enough; the night, also. My work requires me to travel quite a bit. I live aboard an airplane, my mobile office."

I listened and imagined how a late night airplane would land, take aboard a lone traveller, and race away into the night, away from the southern city, toward Moscow. A man is sitting and working in the passenger compartment. "Good and useful thoughts, like the owl of Minerva which appears at night." His words.

"How does your wife take this?" I asked.

He shrugged his shoulders, and a warmth glowed in his eyes.

"Ask her yourself. Incidentally, I have been lucky in this work, the way things have turned out. We are friends; we understand each other without having to resort to explanations."

Vladimir Fedorovich suddenly grew sad. "People count my awards, but no one wants to count my wounds." Having said that, he added:

"I consider myself to be a lucky person and a successful designer. Nonetheless, I cannot say that I was born under a lucky star. All kinds of things can happen. You are probably of the opinion that a chief designer or general designer spends days and nights at the drawing board drawing and computing, and a new missile or space rocket is born. If only that were so! This is a war of ideas, a struggle involving realities of common sense, not only of engineering. It is a sign of the times that we have all become to one degree or another philosophers, economists, politicians, and managers. One cannot halt this progress, throwing a monkey wrench in the works. The competition with the Americans is not for number of missiles. It is a competition involving design ideas. Also, a new missile costs money. Quite a bit, at that."

He started to discuss testing of one of his new ideas, a so-called "mortar launch."

"Baykonur. The steppe was awakening after the night, with daybreak on the way and the air as clear as ice. A missile rushed skyward out of a silo in the earth. At an altitude of about 20 meters there was a delay lasting only a moment, then—full speed!"

Marshal Grechko, continuing to watch through his binoculars, said uncertainly:

"I was told that it falls back dangerously, and ..."

"It takes off," interrupted Utkin, "without delay; the engine fires at that altitude."

The new version provoked guarded comments and heated arguments. On the evening before the test, V. N. Chelomey said, "It will not go." Following him came an opposing "It will go," said by a sour Utkin in response. "If it does go, Vladimir Fedorovich, I will take off my hat to you." That is what he said, but when the time came, he did no such thing.

Of a firm that takes a long time to "come across," it is said that it has not "found its way." That kind of thinking is all right for a period of five to seven years. If it has not "found its way" after 10 years or so, then this means that the firm is not doing well. It would appear that the idea here is fairly clear and understandable, but it is not to the liking of anyone interested largely in acquiring status and augmenting a personnel roster, by a firm that does not produce. That kind does exist.

There definitely is such a thing as love of power. This is strange to have, of course, but I must admit that there are those who do harbor it, this love of power. But what good is it? Merely to show that a person knows more than anyone else, that he can order people around any way he likes, without fear of consequences, without accounting to anyone? That is nothing but nonsense. If a person is a chief designer, that means that he is good at bringing people together. The main thing here is not that he is the chief, period. He is supposed to function as an prime mover.

"Do you ever have to justify your actions?" I asked Vladimir Fedorovich.

"Justify my actions?" he repeated. "I can recall when we were conducting a test launch of a new item. Quite a lot of people came to see what would happen. When the rocket produced a foxtail, they all ran away in no time. Kurushin (in charge of the test facility at the time) and I hurried to the point of impact to see what had occurred. We were suddenly called in on the carpet so that an explanation could be sent 'upstairs.' I will not tell you in detail about the situation, but I will say that I spoke everything that was on my mind, thus causing consternation. What is needed is the truth, not soothing words. People working for me had their backsides burned by the blast; they are not about to sidestep. After the higher authorities departed, one of the 'yes-men' came up to me and whispered into my ear: 'You are a courageous man.' What an affront! At first he remained silent, later he praised me. 'You did not exhibit courage by supporting me out loud,' I interrupted."

Academician Utkin, Twice Hero of Socialist Labor, general designer of space rocket complexes, had erected in his honor by decision of the government a bronze

bust. Ryazan area people hold their fellow countryman in high regard. Incidentally, we also owe a debt of gratitude to those who created a reliable shield for our Fatherland, those who brought fame to it in space matters. However, something else is in the air: Times have changed; we must disarm. We must! It is our country that has initiated this. Nonetheless, in spite of the forthcoming Soviet-American agreements on reduction of strategic armaments, the Americans are stubbornly and in some ways secretly continuing their work on creating new missiles as replacements for the aging Minuteman-2. Let us put that onto the scales and try to predict what may come of that. I personally do not care to make any such predictions at the present time.

My early-morning telephone call to Vladimir Fedorovich was not early enough to awaken the academician. He was hurriedly preparing to visit the Supreme Soviet. He apologized for not being able to meet with me in the next few days. "I must explain to someone what conversion is and what kind of conversion the country and people need." "Are there any serious opponents?" I asked him. "No, there are dangerous amateurs," answered Vladimir Fedorovich. The chief executive designer must have spent another night working and thinking.

As he was about to leave, Vladimir Fedorovich requested that I in my narrative do not overdo it—exalting him above those with whom he has become accustomed to share the labor and cares, the aggravations and joys, the defeats and successes. I promised to abide by his request.

Galeyev Discusses History, Prospects of Institute of Space Research

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[Article by Albert Abubakirovich Galeyev, director of the USSR Academy of Sciences Space Research Institute and corresponding member of the USSR Academy of Sciences, under the rubric "Observatories and Institutes": "The USSR Academy of Sciences Space Research Institute—the Center of Soviet Space Science"; first paragraph is source introduction]

[Text] **The USSR Academy of Sciences Space Research Institute has turned 25, which gives us occasion to recall its accomplishments and to say something of its future.**

In the late 1960s, on Starokaluzhskoye Shosse [Starokaluga Highway], a new, 12-story building arose on the outskirts of Moscow. Housed in it was the USSR Academy of Sciences Space Research Institute. It was a symbolic coincidence: our country's space science had its beginnings in the small Russian town of Kaluga, which is rightly called "space" Kaluga or the city of Tsiolkovskiy. The front of the institute's building looks out on a square that bears the name of a prominent Soviet scientist, Academician M. V. Keldysh, who made a substantial contribution to the development and realization of the Soviet space program and who participated directly in the organization and founding of the USSR Academy of Sciences Space Research Institute.

Established in 1965 on the basis of a number of dividions and laboratories from various institutes of the USSR Academy of Sciences and other departments, the Space Research Institute became the head organization of the USSR Academy of Sciences and the Intercosmos Council in the field of scientific research involving space, the solar system's planets, and astrophysical objects. It was entrusted with preparing and supporting programs for space research, developing, testing, and using scientific equipment for that research, and ensuring international cooperation in the performance of experiments in space.

The Space Research Institute's structure is determined by the basic tasks of scientific-technical activities. The institute includes divisions and laboratories such as those for space plasma, planetary research, experimental and theoretical astrophysics, space-based materials science, and optico-physical research, as well as divisions for scientific-technical support of experiments on unmanned and manned space vehicles. The institute has a powerful computer base for processing scientific data, its own pilot production facility, engineering and equipment divisions, a checking and testing station, a scientific-technical information division, and a patent-and-licensing division.

Subordinate to the institute is the Special Design Bureau in the city of Frunze. In the city of Tarusa (Kaluga Oblast), a new pilot production facility for scientific space equipment has been established and is being developed further. The Space Research Institute's subdivisions at the cosmodromes conduct the final tests of scientific instrument packages just before the launch of a space vehicle. At the Deep Space Communications Center in Yevpatoriya is the institute's terminal station, which processes and transmits scientific-technical data during the performance of experiments aboard space vehicles.

For nearly 10 years, the Space Research Institute was headed by its first director, Academician G. I. Petrov. From 1973 through 1988, Academician R. Z. Sagdeyev was director of the institute. In 1988, A. A. Galeyev, corresponding member of the USSR Academy of Sciences, was elected director. Associated with the institute have been the names of prominent scientists of our country such as Academician Ya. B. Zeldovich and I.S. Shklovskiy, corresponding member of the USSR Academy of Sciences. Working in the Space Research Institute now are two corresponding members of the USSR Academy of Sciences, around 50 doctors of science, and more than 170 candidates of science.

The Space Research Institute's research associates have taken an active part in preparing scientific instrument packages, conducting measurements and obtaining and processing of data from space vehicles launched for the

Soviet national program (the Cosmos and Prognoz satellites, the Luna and Venera unmanned probes, the manned Soyuz ships and the Salyut orbital stations), as well as for projects carried out within the framework of international cooperation: Soyuz-Apollo, ARAKS [Franco-Soviet project], Sneg [Snow], Raduga [Rainbow], Intercosmos, Vega, Fobos, and others. Obtained in those projects were important and, in many instances, top-priority scientific results that ensured the Soviet Union cutting-edge positions in space resurch. At the same time, it is necessary to keep in mind that, over the last 20 years, the expenditures for space research, which are always disclosed to the public, have not exceeded two-three percent of all the outlays for space in the USSR.

Plasma Research

Among the basic areas of the theoretical and experimental research performed in the USSR Academy of Sciences Space Research Institute is the physics of space plasma. Quite a few world-class results have been achieved in that area. They primarily involve the study of the composition and the parameters of the plasma in the Earth's magnetosphere. The inner portion of the magnetosphere is the plasmasphere, which was discovered by Space Research Institute associates on the first space probes and which is filled with a relatively cold ionospheric plasma whose temperature is on the order of several thousand Kelvin. But accumulating in the outer region adjacent to the plasmasphere are accelerated, charged particles with considerably greater energy—the plasma's temperature there is on the order of a billion Kelvin. The Earth's magnetic field, which forms a unique magnetic trap, holds the charged particles for a long time. Detailed research performed on the Prognoz satellites has indicated that the interaction of those particles and the cold plasma leads to the warming of the plasma in the outer layers of the plasmasphere to 10,000 Kelvin or higher.

Research on the paths of penetration and migration of the solar plasma within the magnetosphere has been conducted through the observation of "natural labelled atoms"—ions of helium and oxygen (on the Prognoz satellites)—as well as from the glow of excited molecules in the upper layers of the atmosphere (on the Aureole and Intercosmos-Bulgaria-1300 satellites).

The Space Research Institute's scientists, together with their Czechoslovakian colleagues, conceived and carried out the joint Intershok project, which was aimed at a detailed investigation of the mechanisms for the dissipation of energy and the acceleration of particles at the near-Earth shock front that forms in the supersonic flow of solar plasma just in front of the Earth's magnetosphere. That seemingly narrow task is of enormous importance for the understanding of the mechanisms underlying the emission and acceleration of particles in the various astrophysical processes (for example, the plasma jets from the cores of active galaxies into the interstellar medium and the interaction of the shells of supernovas with the interstellar medium). The Intershock project conducted integrated research on plasma, energetic charged particles, plasma waves, and electric and magnetic fields near the near-Earth shock wave, which is quite accessible to us. That research led to the discovery of a new mechanism for the acceleration of electrons by resonance plasma waves excited at the shock front. In addition, the measurements of the plasma's parameters, made at record speeds, have made it possible to obtain fundamentally new data about the energy dissipation processes in shock waves.

From the standpoint of the prospects for investigating the Earth's magnetosphere, two basic research areas should be pointed out. The first is a more global task—the investigation of the effect of solar activity on the Earth and near-Earth space. That is why the Earth's magnetosphere emerges here as one of several components of the solar-terrestrial system (sun—solar wind—magnetosphere) that are closely interrelated with one another. The second area involves comparative studies of planetary magnetospheres, which makes it possible to identify common patterns and special features attending the physics of the various planets' magnetospheres.

Plasma and plasma-wave measurements performed during the flights of unmanned probes to the planets Venus and Mars, as well as to Halley's Comet, have made it possible to track the special features of the magnetospheres that make the parameters of the atmospheres and magnetic fields of those planets different from those of Earth. However, what remains the main thing for us is the research on the solar-terrestrial relationships that requires the creation of a network of satellites to monitor all the key regions of the system. And such a network will begin operating in space as a result of the combined efforts of the space agencies of the United States, the USSR, Europe, and Japan. The first contribution to this network will be the Interbol project, which is expected in 1992 to launch a Prognoz satellite with a Czechoslovakian sub-satellite to the region above the polar auroras and another such pair of satellites to the nearby region of the Earth's magnetic tail (energy accumulates there and feeds the polar auroras, magnetic storms, and other processes). In 1993, that network will be supplemented by another Prognoz satellite for research on the background radiation of the universe, but it will also carry a small set of plasma instruments. In order to understand the effect that the cyclic nature of solar activity has on the Earth and the near-Earth medium, observations need to be made from a network of space vehicles for a long period of time. That is why the international program for such research is intended to last almost the entire next decade.

After the Interbol project is completed, international research is expected to continue with small space laboratories developed by the Space Research Institute's scientists and specialists. The relatively low cost of such space vehicles is achieved by the use of a number of fundmentally new designs—particularly, solar sails that maintain a vehicle's constant orientation in the direction of the sun. Such vehicles are also associated with a high level of magnetic and

chemical purity and orientation precision, as well as a prolonged period of active operation.

The program of extra-atmospheric solar research for the years 1990-2000 calls for systematic observations over the course of the 11-year cycle of solar activity and is based on the use of the series-produced AUOS-SM space vehicle. In that program, the leading role will belong to other institutes of the USSR Academy of Sciences, and the Space Research Institute will assist them in the development and testing of scientific instrument packages.

In the vast program of planned solar research, a special place is occupied by the Tsiolkovskiy project proposed by the USSR Academy of Sciences Space Research Institute and the NPO [Scientific Production Association] imeni Lavochkin. Within the framework of that project, a special probe will be developed and will be inserted into a trajectory toward the Sun through the use of Jupiter's gravitational field. That will make it possible to take measurements within the internal part of the heliosphere, which consists of the areas closest of the sun and is practically the only unstudied region of the solar system.

Planetary Research

Planetary research is conducted with optical and infrared spectrometry, photometry, infrared radiometry, mass spectrometry, gas chromatography, and fluorescent X-ray spectrometry. Meteorological measurements are taken on the surfaces of the other planets.

In the Space Research Institute, a great deal of attention is being devoted to the elaboration of theoretical problems in the modeling of processes in the planetary atmospheres.

The Space Research Institute has participated in the preparations and conduct of virtually all the space missions associated with studies of the planets. Each time, new goals have been set, and the methods and scientific instruments have been substantially improved from flight to flight.

The direct study of Venus and Mars has made it possible to ascertain the interrelationships and specific nature attending the formation of natural complexes that are different from our planet and has led to a better understanding of the Earth's evolution. That is important also for the study of the effect on the Earth's atmosphere of human economic activity, as well as for the study of the possible climatic changes associated with atmospheric pollution.

In the mid-1980s, the first important step was taken in the execution of a program of research involving small bodies by means of spaceborne hardware—the widely known Venus-Halley's Comet project got under way, marking the transition to close international cooperation which has completely proven its value.

A fundamentally new stage in the program of solar system research via rocket-space hardware was represented by the integrated, multipurpose Fobos project, which included investigation of the Martian satellite, Phobos, the planet itself, the Sun, and the plasma on the flight path and in the vicinity of Mars. Of course, the Martian satellite was one of the main targets of the mission of the interplanetary probes. It was in that stage, in the words of the project's scientific director, Academician R. Z. Sagdeyev, that the most original and bold ideas were concentrated, supported by a unique equipment base.

Unfortunately, the Fobos project's program was not fully executed, but, with the stations' on-board instruments, we did manage to obtain a great deal of new data on solar activity, the interplanetary plasma, the magnetic field of Mars, the Martian surface, and Phobos itself.

The experience garnered over the past few years in space-based planetary experiments has shown that the most efficient programs in terms of scientific results are those that include a number of flights to the same object at intervals of several years. That is precisely how it was with the Moon and Venus. Now a detailed program has also been worked out for Mars. Its first stage is scheduled for 1994 (the Space Research Institute is the head organization in the Mars-94 program). The program calls for global studies of its surface and atmosphere from artificial satellites of the planet, balloon probes released into the atmosphere, and meteorological stations and penetrators delivered to the Martian surface. Plans are to continue the research on Mars in 1996, with the return to Earth of soil samples from Phobos. In 1998, the first self-propelled vehicle in the history of planetary research (the Marsokhod [Martian Rover]) with a drilling rig on board is to begin operations on the surface of Mars. Samples of the Martian soil are to be delivered to Earth in 2001, and systems for a manned Mars mission are to be tested in 2003-2015.

Astrophysical Research

The Space Research Institute's scientists are conducting space-based astrophysical research in all ranges of the radiation spectrum. Simultaneously, theoretical work is also being conducted in astrophysics, cosmology and extragalactic astronomy.

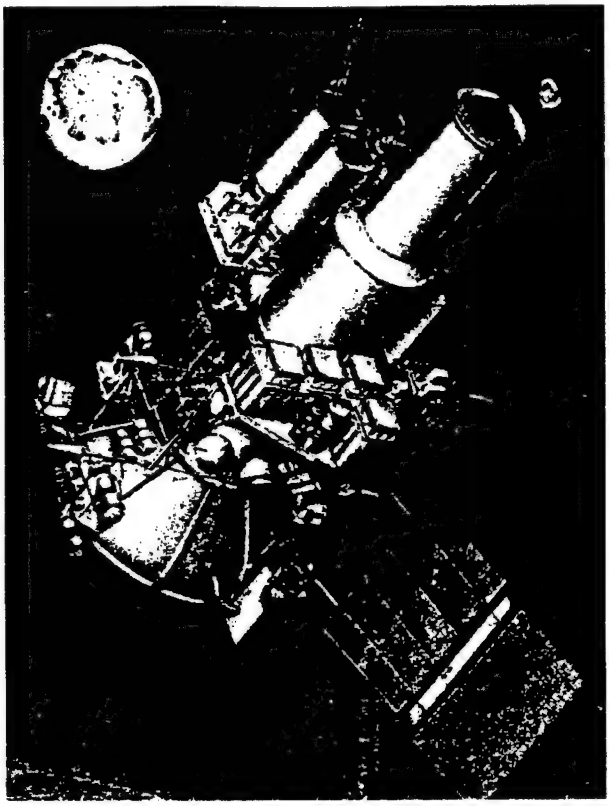
The development of extra-atmospheric astronomy has gone in three principal directions. For astronomical observations, use has been made of telescopes installed on manned space vehicles (the Salyut stations and the Soyuz craft). The astronomical instruments were part of scientific instrument packages and unmanned multipurpose vehicles (satellites of the Kosmos and Prognoz series and the Venera interplanetary probes). And, finally, recent years have seen the development of specialized space vehicles for astronomical research. The first of them was the Astron satellite.

The Rentgen Observatory has been operating in space since 31 March 1987. That observatory makes it possible to conduct research in the energy range of 2-1300 keV. It consists of four X-ray telescopes designed to solve the fundamentally new problems of high-energy astrophysics. The largest of them—the Pulsar X-1—was developed in the Space Research Institute jointly with scientists from a number of the country's other scientific and production organizations.

Within the framework of the Rentgen project, several thousand observations have already been conducted on

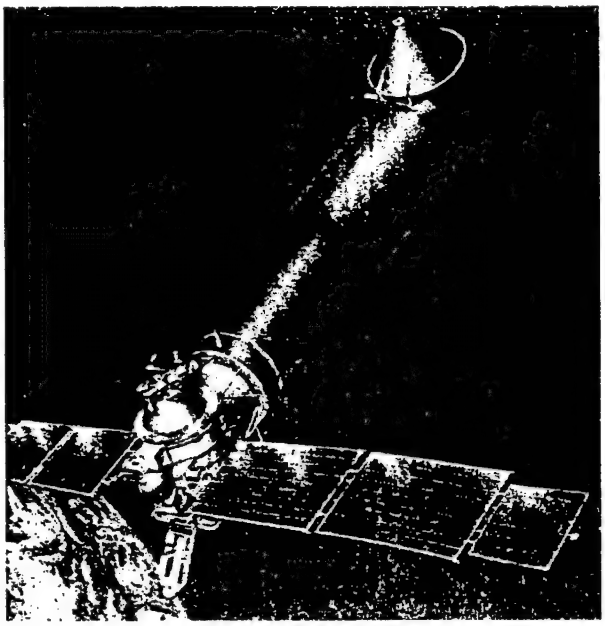
the Kvant astrophysical module, and important scientific results have been obtained. Of greatest interest, undoubtedly, are the world's first and only regular observations of the hard X-ray radiation of supernova 1987A. As noted by R. A. Syunyayev, the scientific director of the project and a corresponding member of the USSR Academy of Sciences, the supernova shell that formed after the explosion has shattered into pieces (it has an irregular shape and a heterogeneous chemical composition). Observations of the distribution of the heavy elements (iron and cobalt) that formed during the process of nuclear fusion in the star's core make it possible to surmise that, during the explosion, they were mixed with the light elements (hydrogen and helium) that are contained in the outer shell of the ancestor star.

On 1 December 1989, another astrophysical observatory was launched—Granat, which was designed to conduct research in the 3-2000 keV range. The observatory's basic instrument package includes the Franco-Soviet Sigma telescope and the Soviet ART-P. The ART-P X-ray telescope, developed by scientists from the USSR Academy of Sciences Space Research Institute, consists of four identical modules with parallel optical axes. The basic research targets are neutron stars, black holes, white dwarfs, the remnants of supernova explosions, our galaxy's interstellar medium, molecular clouds, the center of our galaxy, extragalactic objects, the universe's background X-ray radiation, and cosmic gamma-ray bursts.



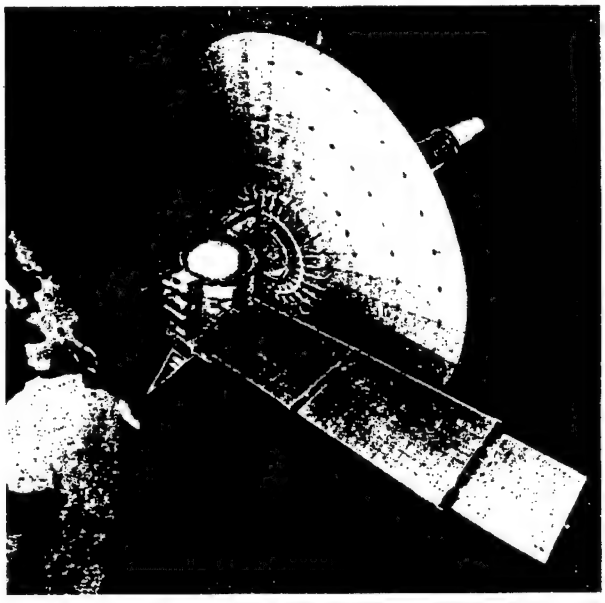
Granat spacecraft

July 1990 saw launch of the largest gamma-ray telescope ever in space, the Gamma-1, which was designed to perform extra-atmospheric observations over the 50-5000 MeV range.



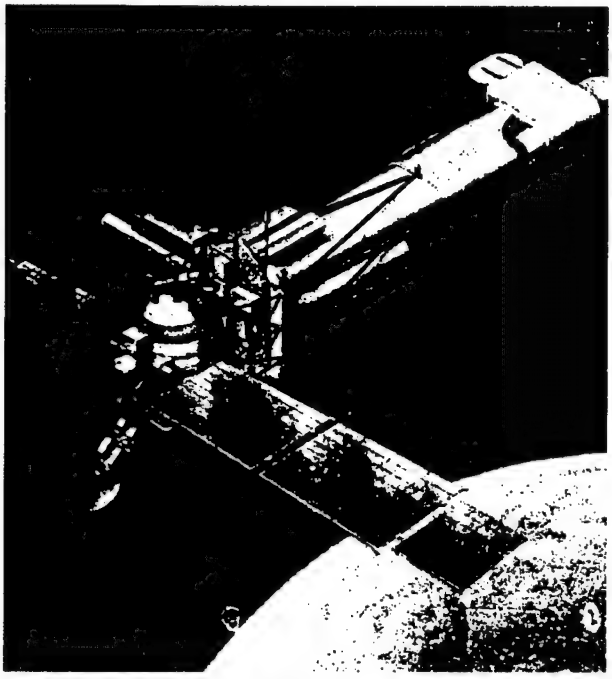
Spektr-UFT spacecraft

Plans have been made to carry out the following projects in the Soviet Union over the course of the next decade: Spektr-RG (gamma and X-ray radiation); Spektr-UFT (ultraviolet radiation); Aelita (submillimetric radiation); Relikt-2 (background radiation); and Spektr-R (ground-space radio interferometer).



Spektr-R spacecraft

For three of those projects (Spektr-RG, Aelita, and Relikt-2), the Space Research Institute is the head organization, while, in the Spektr-UFT project, our institute is participating indirectly. The development of the Spektr-R project was begun in the Space Research Institute, but is now being continued in the USSR Academy of Sciences Physics Institute. We hope that the Spektr-RG orbital observatory will be one of the most important sources of new information about the universe. The sensitivity of the observatory's primary telescopes in the standard X-ray band will exceed that of the equipment on the Kvant module and the Granat observatory by a factor of 1,000.



Spektr-RG spacecraft

Applied Areas

From virtually the beginning of the existence of the USSR Academy of Sciences Space Research Institute, the institute's work has included an area associated with the use of space technology for the study of our own planet and for the organization of efficient management of its natural resources. Developed jointly with the GDR were the MKF-6 multiband space camera and the multichannel projector. Today, they are being manufactured in series production by industry and are used successfully in many scientific and production organizations in the USSR and abroad.

Based on optoelectronic methods for investigating the Earth from space, the institute's specialists, together with a number of Soviet and foreign organizations, have developed the Fragment multiband scanning system, which makes it possible to obtain prompt multiband video information with good spatial resolution about changes that are occurring rapidly on the Earth's surface.

The Space Research Institute has done a great deal of work on the development of airborne laboratories. They are needed for surveying relatively small regions and are used in the testing of space equipment and in the refining of information obtained from space. Work has been done in the field of aerospace research using radiophysical methods—radio oceanography, hydrophysics and remote investigation of the atmosphere. Initial data have been worked out for various scientific programs, and spectral and panoramic remote atmospheric sensing instruments have been developed.

Of important applied significance is the basic research performed in the institute in the field of geophysical hydrodynamics. That research is being conducted in two basic areas. The first is the search for the initial physical causes of such natural catastrophic phenomena as typhoons, cyclones and tornadoes. The second is the identification of processes that are most interesting from the standpoint of the study of the nature of various anomalous phenomena in the atmosphere, the ocean, and the ionosphere.

Pertinent to the important applied areas, as well as to the fundamental areas of space research performed by the USSR Academy of Sciences Space Research Institute, is the work in the field of space-based materials science. The long-term practical outcome of this work is the production of materials with improved characteristics. In the majority of instances, that work is being carried out in cooperation with scientists from other countries.

The Institute's Data Processing and Computer System

A great deal of work is being carried out in the institute on the design and development of systems for processing scientific data, the automation of scientific experiments, and the development and improvement of software and hardware for the collection, processing and transmission of data in the preparation and conduct of research.

The institute has a powerful computer base capable, overall, of performing several hundred million operations per second. In recent years, along with the use of supercomputers, an alternative area has been developed—the development of computer systems that use parallel matrix processors linked to a central processor. An example of such a high-capacity computer system is the one developed through the joint efforts of scientists from the USSR Academy of Sciences Space Research Institute and the Bulgarian IZOT Association. In operation for several years now, the system consists of several matrix processors connected to a central processor with a peak capacity of 120 million floating-point operations per second or more than 300 million ordinary operations per second. That makes it possible to use the entire system at once for solving a single complex problem and to perform numerical modeling of problems that were inaccessible to previously available computers.

A great deal of attention is being focused in the institute on digital processing of video data. A system of hardware and software has been developed for automated video data processing that meets the high requirements of users in the most diverse spheres of activities. Such systems are being used to conduct thematic analysis and processing of images, the observation of natural processes in a quasi-real-time mode, and the classification of those processes according to production spheres.

Problems of statistical processing of spacecraft telemetry and trajectory data have been solved. A number of questions of navigational support for new space projects have also been dealt with, thereby making it possible to find the optimum trajectories for a flight to objects of the solar system (for example, trajectories have been researched for a flight to the asteroids with a preliminary fly-by of Venus, Earth and Mars, and the possibility of using a gravity assist near Jupiter for a flight to the vicinity of the Sun has been examined, as has been a flight to Saturn and its satellites).

Addendum to article:

On 19 October 1990, the prominent Soviet scientist Albert Abubakirovich Galeyev, who is director of the USSR Academy of Sciences Space Research Institute and a corresponding member of the USSR Academy of Sciences, celebrated his 50th birthday.

The editorial staff warmly congratulates him on that anniversary and wishes him good health and fruitful activities for the benefit of Soviet science.

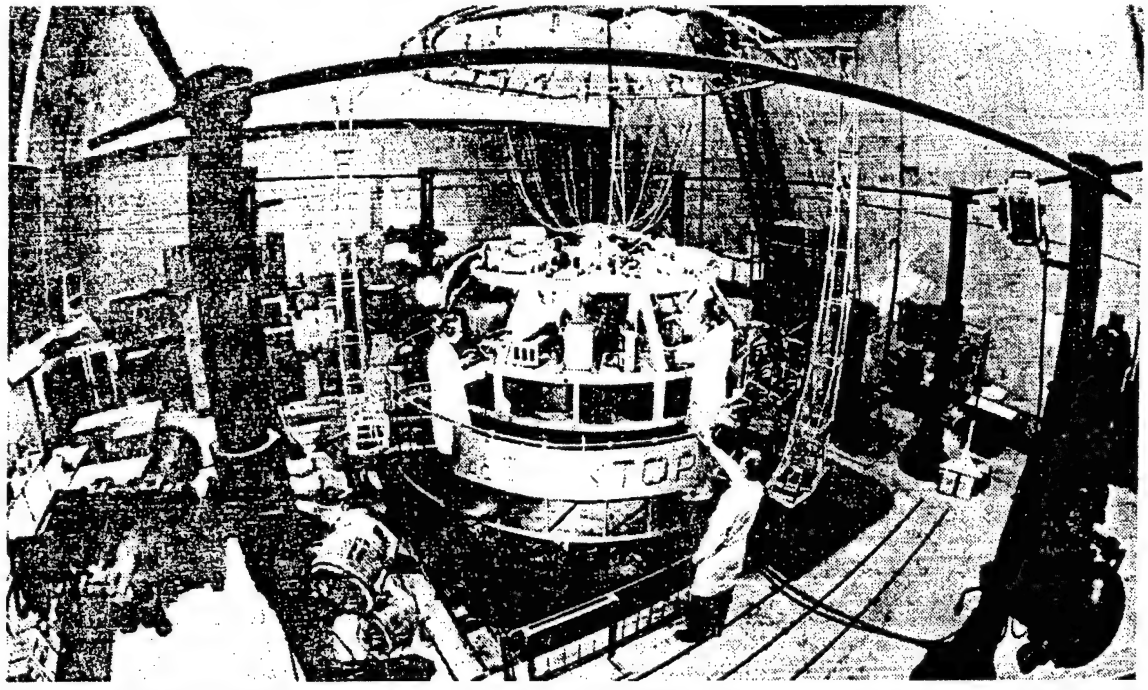
Central Specialized Design Bureau in Kuybyshev

917Q0102 Yerevan GOLOS ARMENII in Russian
15 Jan 91 p 2

[Unsigned: "Kuybyshev - The Road Into Space"]

The Central Specialized Design Bureau in Kuybyshev is a lead enterprise in our country for the development of rocket and space technology for the study of space for peaceful purposes. Here were born rocket boosters and spacecraft for study of Earth's natural resources and monitoring of the environment, as well as for biomedical and other research. Today the designers are involved not only with space matters, but also with problems on Earth. They are performing a large amount of work to create complexes for processing agricultural products and to develop equipment for production of chocolate goods and many other things. This important direction in their activity is determined by the policy of conversion.

First steps have been taken in the area of international cooperation. Specialists of this Bureau have concluded agreements with firms in France and the FRG for spacecraft launches on a commercial basis.



"Vektor" dynamic test stand. Systems for control of space craft are developed here and conditions of space flight environment are simulated.

Reshetnev, 'Krasmash' Plant Director Visit School for Young Cosmonauts

917Q0093A Moscow PRAVDA in Russian 26 Mar 91 p 1

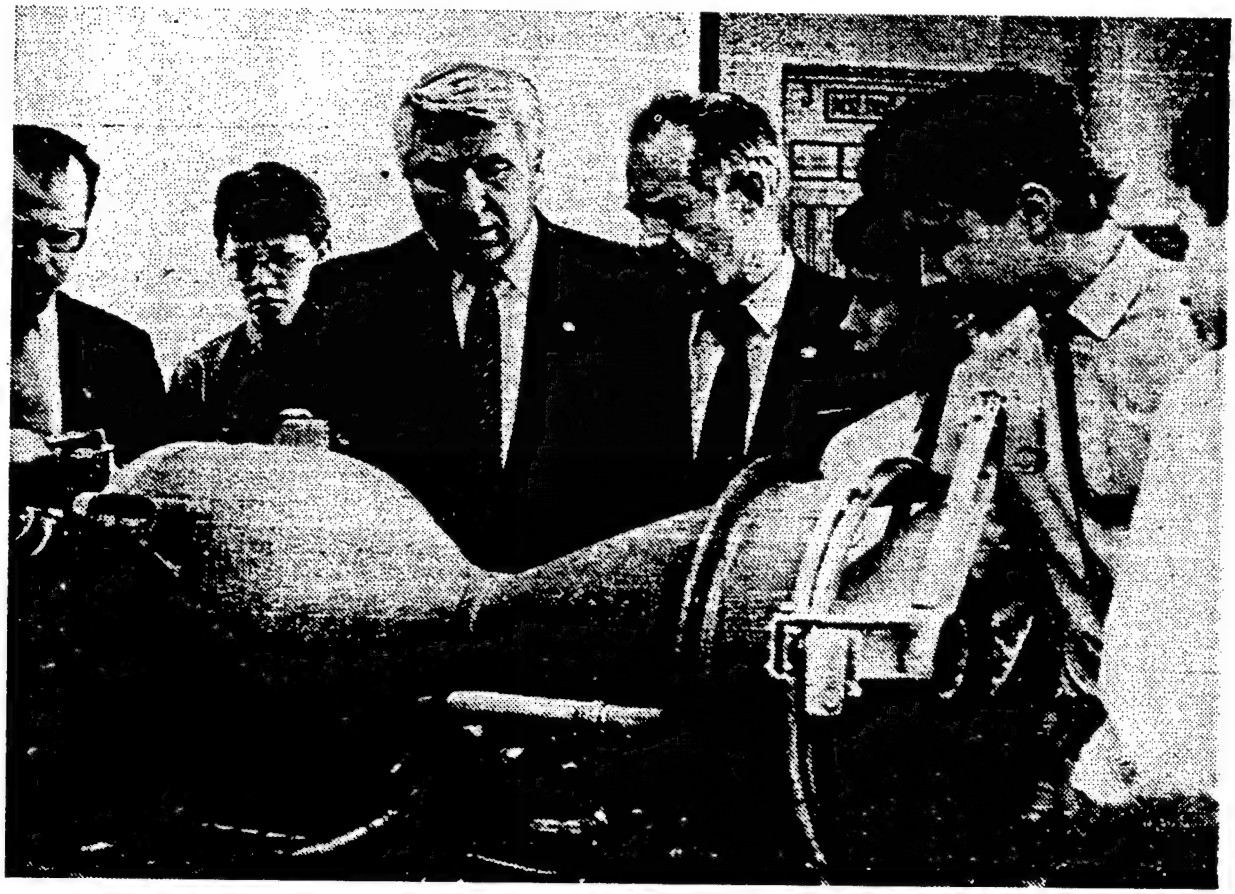
[Article by PRAVDA special correspondent N. Krivomazov (Krasnoyarsk): "Adolescents From Zaozernyy"]

[Text] In past times the idea of keeping one of these photographs as a souvenir in a family album—much less the thought of publishing it in a newspaper—would have been unthinkable. It wouldn't even be said as a joke! Academician Reshetnev, the second space designer after Korolev, next to Gupalov, general director of, to put it mildly, an extraordinary plant. And here the address is also indicated: The space designer works near Krasnoyarsk in the small town of Zaozernyy, which up to now has been closed, while the Krasnoyarsk Machine Building Plant of Gupalov produces, you yourselves understand, not only luxurious two-compartment Biryusa refrigerators....

"Among the large number of our vital problems the very important task of training skilled personnel is emerging. Such a system is required so that from childhood it would inculcate a taste and skill for scientific and engineering creativity. The public education system should serve these goals. However, the structure, which has formed in it at present, does not make it possible to accomplish the posed task, and the restructuring of all public education still lies ahead, but this process is a lengthy one.

"The way out of the situation has been known for a long time—the differentiation of instruction and the establishment of a network of specialized schools. One of them is the school of astronautics in Krasnoyarsk under the university and the Institute of Space Engineering.

"The International Youth Space Center was established in Krasnoyarsk," V. Gupalov continues, "for further successful activity, for the development of new technologies in the area of equipment, for the devising of new intelligent trainers and science-intensive toys, and for the broadening of contacts with the foreign school. Executives of higher educational institutions and large enterprises of the region became members of the presidium of the center.



Academician M. Reshetnev and V. Gupalov, director of the "Krasmash" Plant, with students of the school of young cosmonauts

What brought M. Reshetnev and V. Gupalov together in Zaozernyy? The school of young cosmonauts, as its founders nicknamed it. "Krasmash" Director and Hero of Socialist Labor V. Gupalov relates:

"In the fall Harvard University Prof. Darrel Hoff and his wife visited the boarding school. He is a specialist in educational programs in physics and astronomy. There were many interesting conversations. In the United States they treat our educational system with much respect and believe that our syllabuses in the area of the natural sciences are better. This statement of the professor was by no means a gesture of politeness, other American teachers have spoken similar words in conversations at home. This leads to the idea that we in our country have a competitive commodity—our educational methods. And representatives of another American university—the University of Alabama in Huntsville—confirmed this idea. At this university at the space and rocket center there is also a school called the 'Space Camp.' A preliminary understanding on the holding during 1991-1992 of two joint school-conferences has been signed. The first of them will be held in Krasnoyarsk, the second will be held in Huntsville. The people from Krasnoyarsk are providing the syllabus and scientific program of both schools.

"The people of Krasnoyarsk are announcing their own competition on this theme. The winners will be invited to the International School of Astronautics in July 1991."

Society Formed To Improve Level of Soviet Astronomy

917Q0062 Moscow PRIRODA in Russian No 10, Oct 90 pp 78-82

[Interview with N. G. Bochkarev, co-chairman, USSR Astronomical Society, and Yu. N. Yefremov, a board member, by correspondent N. D. Morozova: "Raising the Level of Soviet Astronomy"; first two paragraphs are source introduction]

[Text] A founding congress of the USSR Astronomical Society was held early in April. More than 270 delegates from 80 scientific organizations and academic institutions adopted a resolution on the creation of an astronomical society and approved its charter. Ten working commissions were formed at the congress, and a board was elected, as were three co-chairmen—N. G. Bochkarev (State Astronomical Institute imeni P. K. Shternberg), V. G. Gorbatskiy (Leningrad State University) and A. A. Sapar (Astrophysics and Atmospheric Physics Institute, Estonian Academy of Sciences).

N. G. Bochkarev and a board member, Yu. N. Yefremov, tell correspondent N. D. Morozova about the problems facing the society and about the situation in Soviet astronomy.

[N. D. Morozova] Recently, a multitude of various societies, associations and clubs have sprung up: the USSR Nuclear Society and the Moscow Power-Engineering Club were organized; not so long ago, PRIRODA reported on the founding, or to be more correct, the resumption of the USSR Physical Society[1]; finally, the USSR Union of Scientists has been formed. And now your society has been established. Isn't this simply doing what is in vogue?

[N. G. Bochkarev] It was, without a doubt, the changing situation in the country and the processes of democratization that are under way here that stimulated the establishment of the Astronomical Society. But the idea of the need for a professional society of astronomers was born some 20 years ago. The principal motive was to unite active researchers so that, together, they could raise the level of Soviet astronomy. At the moment, we are lagging behind considerably. Our contribution to world astronomical science has fallen to several percent, and we are no longer a great power in that field.

[Yu. N. Yefremov] As before, the administrative-command style of leadership prevails; real authority has for decades been concentrated in a few hands, and the scientific community is often simply unaware of decisions made "at the top." Cooperating with the existing official structures, without replacing them, a society of professional astronomers could exert an influence on decisions being adopted.

[N. D. Morozova] It seems that there is a Joint Scientific Council for the Complex "Astronomy" Problem (JSCA) in the USSR Academy of Sciences, and to a considerable extent, it is creating and implementing the program of astronomical research in our country. You feel that that's not enough?

[N. G. Bochkarev] First of all, don't forget the lack of coordination among departments, and there are astronomers not only in the Academy, but also in the state educational system and departmental institutes and organizations. For example, the Leningrad Optical-Mechanical Plant, where telescopes are made, and the NPO [scientific production association] Astrofizika, which is engaged in a related research area. That's why it is entirely natural, at least at the level of a society, to set up a structure that could break down interdepartmental barriers.

In addition, we weren't satisfied with the fact that many decisions in the field of astronomy were being made as the result of lobbying or were made too slowly, and, in many cases, the latest scientific advances weren't being taken into account when the decisions were made.

[Yu. N. Yefremov] A classical example of that is the choice of the site for the construction of the 6-meter telescope of the USSR Academy of Sciences. It's an old story, the site that was chosen was by no means the best, and how it was decided on was known to only a small group of individuals, and the scientific community wasn't let in on the discussion. And we don't want a repetition of that situation with the project involving the 25-meter sectional optical telescope. There is no doubt as to the need for large instruments, but their installation site, their design, and many other matters must be widely discussed.

In the past, when our country launched instruments into space, everything was done in deep secrecy right up to the last moment, and the absolute majority of the scientific community learned about it after the fact, after the launch. For example, in your journal, in the section "Science News," I read that the Glazar ultraviolet telescope had been installed on the Kvant module. It is not entirely clear to me why that was done, because the international ultraviolet IUE satellite has been in space now for almost 10 years, and it observes all the most important sources in that very UV range of the spectrum, and the results are accessible to everybody. In addition, our Astron satellite has long been in operation. It is entirely possible that there are special features in the Glazar science program that explain the need for its launch, but, unfortunately, few people are aware of them.

[N. D. Morosova] In other words, you were not satisfied with the existing system for making decisions?

[Yu. N. Yefremov] That's absolutely right. Incidentally, in addition to the JSCA, there is yet another governing agency—the Astronomical Councilof the USSR Academy of Sciences; it is made up of different sections and working groups, not all of whose members, of course, are working astronomers. Nevertheless, it is the JSCA that is of decisive importance, and it consists of members of the Department of General Physics and Astronomy and directors of astronomy organizations (about 25 individuals, in all); it includes two-three academicians who have "ruled" astronomy for more than 30 years now.

I want to emphasize that we are not creating an alternative governing system, but a forum in which alternative solutions can be advanced and discussed.

After all, it's not just poor technology that's causing our lag. At this very moment, there are tasks in which world-class results could be obtained even at the level at which we are equipped. For example, in order to determine the Hubble constant more reliably (the No. 1 objective of the Space Telescope that was launched into orbit), the near galaxies must be systematically surveyed to study the variable stars in them. But all three of our large telescopes (a 6-meter and two 2.6-meter) were built in places with mediocre astroclimate and are, therefore, quite inefficient.

Our science, including its manpower, is concentrated for the most part in Moscow and Leningrad—where there are more highly skilled specialists than in all the remaining astronomy organizations of the country taken together—but there are no large telescopes at their disposal.

[N. D. Morozova] Then how do you intend to change the situation?

[N. G. Bochkarev] Our objective is to mold public opinion and carry it to the "astronomy authorities." We can cite the experience of the American Astronomical Society, also a public organization which has no real capability of distributing money. But from decade to decade, by means of commissions, it has been developing an astronomical research program by singling out the most state-of-the-art, progressive projects and recommending them (extremely successfully, at that) to government institutions.

[N. D. Morozova] Could VAGO—the All-Union Astronomical-Geodetic Society—handle that perhaps?

[Yu. N. Yefremov] That society brings together not only astronomers, but also geodesists; in actuality, the astronomers in it are represented, for the most part, by amateurs; there are few professionals, which is particularly the case in Moscow.

[N. G. Bochkarev] The professionals in the society are diluted in a ratio of 1 professional per 100 amateurs or geodesists, and being on an equal footing with everyone else, they can't solve their professional problems, of which there are a very great many. In addition, VAGO sprung up in the extremely reactionary 1930s in place of the disbanded astronomical societies and, naturally, adopted in full measure an administrative-command work style that didn't meet all the needs of the amateurs.[2]

[Yu. N. Yefremov] In actuality, astronomy and geodesy don't have any common problems now. Earlier, for example, the shape of the Earth had to be determined; that's a problem for higher geodesy that merged with practical astronomy. Now, however, it's an independent field of science and the interests of astronomers have shifted to other fields. Astronomers no longer are involved in cartography or reckoning time. And it's no accident that the world community has long had an independent International Union of Geophysics and Geodesy and an independent International Astronomical Union.

[N. G. Bochkarev] Naturally, a new society, even if it be professional, constitutes competition for VAGO because even amateurs may be drawn upon for work in it. But both international and internal experience has shown that any monopoly is bad. However, having broken the monopoly, but in no way making claims on the functions of VAGO, we hope to arrange cooperative efforts with it.

[N. D. Morozova] You stated that the idea of a need for a professional society was born a little under 20 years ago. Why did it take so long to come about?

[Yu. N. Yefremov] As early as 1972 I prepared a draft of a charter for an astronomical society and discussed it with specialists of the Special Astrophysical Observatory (SAO) of the USSR Academy of Sciences and with some individuals from the then-leadership of the Astronomical Council. The draft was met with interest, but then all the interest died out. A familiar picture, isn't it? But in the late 1980s, when projects began to be put forward on a competitive basis, people had to start "beating the

bushes" for grants, and the fate of many began to depend on what bureaucrats decided. That's when public opinion was finally formed.

In January 1989, a small, highly motivated group gathered at the State Astronomical Institute imeni P. K. Shternberg; in that group were specialists from the State Astronomical Institute, the Institute of Terrestrial Magnetism, Ionosphere and Radio Wave Propagation, Leningrad University and the Pedagogic Institute imeni A. I. Gertsen, the Astronomical Council, and other organizations. In April, a resolution on the need for a professional society also was adopted by the JSCA, but all subsequent work was carried out by the initiating group.

[N. G. Bochkarev] The first official act was the dissemination of 1,500 questionnaires; about 500 answers were received. The statistics, generally speaking, were good: the overwhelming majority of those queried affirmed the need for organizing the Astronomical Society and indicated their readiness to join it. A revealing detail: only 13 percent felt that the society should be part of the USSR Academy of Sciences. Various possibilities were considered—for example, as part of the Moscow Soviet or the Leningrad Soviet—

[N. D. Morozova] Or as part of the Russian Academy of Sciences—did you discuss that possibility?

[N. G. Bochkarev] No, we didn't, because we weren't yet sure exactly what that academy would be; nevertheless, we wanted to be associated with something quite democratic.

[N. D. Morozova] How do you intend to begin your work?

[N. G. Bochkarev] First, we want to fill the numerous ecological gaps that official structures aren't paying attention to, even though those problems are becoming pressing. For example, astronomical congresses were held four times in our country from 1917 through 1928, after which there was a 60-year hiatus, and our founding congress is the first such forum. That's why one of the tasks of the Astronomical Society is to call congresses at which there can be broad, interdisciplinary discussion of the problems involved in developing our science.

Then there is the matter of up-to-date publications: astronomy is developing very rapidly, the average lifetime of an individual study is five-seven years, and in our country it takes two or more years for the results to reach the reader. We want to establish an independent publishing organ—a publication in which astronomical studies would be published fairly rapidly and in the English language. It would be suitable for review articles, extensive observational data and materials from scientific conferences. There's no room for any of that in our current astronomical journals. We are now holding discussions about this with a Western publishing house. In addition, plans are being laid to publish a "Bulletin of the Astronomical Society" in the Russian language, particularly for shedding light on the social life of astronomers; there will be a discussion of the work of the Society itself and of official structures, as well as of international astronomical affairs

There are a great many other problems in which the lack of coordination among departments also has a completely unexpected effect—for example, in astronomy education. One idea is to set up schools for the best students, staffed by the best teachers. It would obviously be worth thinking about establishing scholarships or grants for young scientists and even students and about providing them practical training abroad at good universities. But for the time being, those are only plans, because the Society does not have hard currency or agreements with the equivalent scientific organizations of Western countries.

[N. F. Yefremov] I think that there is much work to be done by the commission on ethics and protection of the professional interests and rights of astronomers. Here is one of the problems it needs to solve: for the opportunity to work on the very largest telescope, specialists from the Special Astrophysical Observatory of the USSR Academy of Sciences are spending their lives in a dead-end canyon, experiencing numerous difficulties in everyday life and undergoing psychological stress typical for any isolated group of workers. Most of the specialists in the past have objected to such an administrative solution of the problem, but the enthusiasts of our science have already been paying for it for two decades. The situation suits only local inhabitants, who find it quite a luxury to have, in addition to their farmstead, a good apartment; the percentage of astronomers agreeing to work there is becoming increasingly smaller.

[N. D. Morozova] Would it possibly be better to use the so-called temporary duty, or visiting, work principle?

[Yu. N. Yefremov] Yes, and it would certainly be cheaper, too. The same problem, but to a lesser degree, also exists at the Crimean Astrophysical Observatory, as well as at many other observatories (but only ours!).

[N. G. Bochkarev] And the first thing the commission on ethics and protection of the professional rights of astronomers must do is formulate appropriate proposals for the USSR Council of Ministers and the All-Union Central Council of Trade Unions on putting the profession of "astronomer" into the register of professions, with a description of its special features. It was an absolute surprise to find out that our profession is not listed on that register.

It is equally important to solve the problem of use of astronomical instruments. Even a commission named as such has been established. The idea, incidentally, did not originate with the initiating group. Two weeks before the founding congress of the Astronomical Society, a congress of users of large optical telescopes was held in Odessa. We have very few such instruments and very little mirror area. That's why we're always having a problem distributing work time with them. But first of

all (and this evidently will take at least a year), we need to collect information on what kinds (large and small) of telescopes exist in our country. As paradoxical as it may seem, such information is unavailable at present. We need to to prepare a list of what there is—instruments, their capabilities, who they belong to—and then start deciding how to improve the existing situation.

[N. D. Morozova] These days, one hears more and more about the cluttering-up of near-Earth space with fragments of spent vehicles and space "trash." Does your Society intend to become involved in solving that problem?

[N. G. Bochkarev] Astronomy does, in fact, have its ecological problems. But among the top-priority problems I would also include the problem of protecting the Crimean sky. Very pure in the past and therefore suitable for astronomical research, it is now being polluted in the most outrageous way, and not only by the Bakhchisaray plants discharging cement dust, but also by the surrounding quarries and the enterprises of adjacent settlements, whose floodlights at night shine in the direction of the observatory. As a result of the intensification of industrial lighting of the sky at the Crimean Astrophysical Observatory, the sensitivity of the telescopes decreases 5 percent every year.

[Yu. N. Yefremov] But that can be dealt with. The largest American national observatory is situated on Kitt Peak, approximately 70 km from the rapidly growing city of Tucson, whose population already numbers several hundred thousand. Right after the observatory was built, there was virtually no light from the city. But now the horizon is simply aflame. What did the American astronomers do? They mobilized public opinion: popular-science articles were published, talks were given on local radio, and members of the city council were invited to the observatory. As a result, city officials decided that all street lights had to be fitted with shades that directed the light downward and with filters that did not allow passage of a continuous spectrum (individual lines are no so harmful).

Incidentally, there also is the problem of the "cluttering" of the ether: some organizations do not always pay attention to the ban on operation in the frequency band reserved for astronomical observations.

[N. G. Bochkarev] But there also is a positive side. Astronomical observations are making it possible to solve a number of ecological problems that our cities have. For example, the use of the well-developed method of spectral observations of the sun enables us to track the chemical composition of the Earth's atmosphere on a continuous basis. We are talking about environmental monitoring. It may turn out to be one of the principal areas of commercial contractual activity of our society.

[N. D. Morozova] Is the Astronomical Society capable of earning money independently?

[N. G. Bochkarev] At the moment we do not have a single ruble in our account—but then we were only recently formed. It is clear that we cannot survive on membership dues, because there are so few of us. The charter sets the individual membership dues at 5 percent of one month's salary per year. By a majority vote at the founding congress, it was decided that organizations can be sponsors only; sponsoring assistance can be both money and the leasing or gratis provision of equipment or premises, or the organization of conferences or other Astronomical Society activities.

Now we are counting on the assistance primarily of large astronomical institutions (State Astronomical Institute, Special Astrophysical Observatory, Space Research Institute, Physics Institute, Moscow State University); preliminary agreements have been concluded with them. Incidentally, Moscow State University itself assisted in organizing and conducting the founding congress; it is also prepared to provide one-time assistance in the initial setting-up of the Society.

In general, however, the charter has set down broad possibilities for earning money: the creation of temporary scientific groups, of scientific production associations and of cooperatives, all of whose range of operations will be broad—from astronomical instrument-making to the preparation and dissemination of astronomical illustrations for the popular lectures of the Znaniye Society and for the enormous army of amateurs. Without a doubt, joint publishing activity will be of interest.

[N. D. Morozova] Does the Astronomical Society propose to involve itself in matters of the financing of such major national astronomical programs as, for example, the "Radioastron" project or the X-ray and IR projects?

[N. G. Bochkarev] For the time being, only on a consulting basis.

[Yu. N. Yefremov] For the most part, however, it will study and shape public opinion and then convey that opinion to the "decision makers."

Now, for example, there is a plan for creating a joint observatory of the CEMA countries. But since CEMA is falling apart before our very eyes, the plan must be reworked. It has been suggested that the observatory be built in Central Asia, near Mount Maydanak, in a place with very good astroclimate, with the help of the Carl Zeiss firm. While the precise construction site is being decided upon, it may happen that nobody will be left who wants to collaborate with us. After all, in the northern hemisphere there are equally good places, such as the Canary Islands; in addition, astronomers are more interested in making observations from the southern hemisphere, because from there it is possible to investigate the Magellanic Cloud, the center of the Galaxy, etc. I think our Eastern European colleagues prefer to work at the Southern European Observatory in Chile or on the Canary Islands, not in Central Asia.

[N. D. Morozova] Can it be that nobody needs this "child," and it hasn't even been born yet?

[Yu. N. Yefremov] I fear that that's true. But in any case it would be very important for us to participate, both in observations and in joint projects, at least at the European level. Observation stations are needed in the southern hemisphere—and not just anywhere, but in the neighborhood of the Southern European Observatory, in order to arrange professional contacts and make use of their technical resources.

[N. G. Bochkarev] As for major Soviet astronomical projects, at the founding congress reports were presented on Radioastron, the UV telescope, X-ray projects and the Lomonosov optical project, which in some respects is similar to the West European Hipparchus project, although the Lomonosov project proposes a completely different method; the implementation of the two independent projects will considerably increase the volume and quality of the information.

[N. D. Morozova] Did the science directors of those projects become part of the Astronomical Society board? What, incidentally, is the size of the board?

[N. G. Bochkarev] It was decided not to put a ceiling on the number of board members, so that everyone who wants to test himself in this field would have such an opportunity. As a result, in addition to the three co-chairmen, the board includes 45 other individuals from approximately 30 institutions, the geography of which geography is quite broad—from the Baltic region to Ussuriysk. In general, however, the congress was attended by representatives of all republics in which there are astronomical institutions, and most of them are represented on the board. Since, according to statistics, 20% of all the scientific institutions are in Moscow, 12 of the 48 board members are Muscovites.

[N. D. Morozova] And why was it decided to elect three co-chairman, not just one?

[N. G. Bochkarev] That was proposed by the initiating group, and the congress supported it with a two-thirds majority vote. However, the charter makes it possible to solve this problem differently each time. I think we'll return to it in a year, at the next congress. There is always the danger of growing into some new bureaucratic machine, and we argued a great deal about that. In order to reduce that danger, we finally agreed on establishing co-chairmen.

[Yu. N. Yefremov] Nevertheless, some precautionary measures were taken. It was decided, for example, that the directors of astronomical institutions and councils cannot be board members, and that's exactly why there is not one director of a large project on the board. In my opinion, however, that's a two-edged sword; after all, it would be the most natural form of cooperation between public and administrative structures.

[N. G. Bochkarev] We will strive to reach agreement with existing official structures, at least in order to make their work more public—for example, by publishing in the Bulletin information on decisions they have made. That will represent a step forward. I am sure that, for the most part, the proper decisions are being made, but the public knows nothing about this and therefore these decisions are met a priori with hostility. I hope that glasnost will remove that stress that sometimes arises between the leadership and the astronomical community.

A preliminary agreement has already been reached with A. A. Boyarchuk, chairman of the USSR Astronomical Council (he, incidentally, took an active part in the founding congress), that the Astronomical Society will be informed of the decisions of the Astronomical Council, which deals with all ground-based optical astronomy and has actually taken on broader functions yet. We must also achieve the same cooperation with other councils.

[N. D. Morozova] It seems to me that one of the most distressing problems of present-day Soviet astronomy is that of a lack of leadership associated with the loss of such giants as I. S. Shklovskiy, Ya. B. Zeldovich and A. D. Sakharov.

[N. G. Bochkarev] Unfortunately, I can't offer any consoling words—at the moment, there is no one to replace them. There also has been a period of stagnation in our science. An extremely painful process of replacement of people, a change in generations, is under way. For example, in the generation we belong to, there are, in my opinion, no such leaders, and I hope God helps us to raise them. And that is what, to a large extent, our Society aims to do.

Footnotes

1. "Revived Society," PRIRODA, 1990, No 3, pp 71-76.

2. See in this issue: V. A. Bronshten, "Collapse of Society of Amateur Astronomers," p 122.

Soviet Participation in 1992 Competition for Solar Sail Spacecraft

917Q0067 Moscow IZVESTIYA in Russian 8 Mar 91 Union Edition p 8

[Article by S. Leskov: "Space Race in Honor of Columbus"; first paragraph is source introduction]

[Text] **It has been decided to mark the 500th anniversary Columbus's discovery of America with a race involving giant spacecraft under reflecting sails. Space sailcraft created in Europe, Asia, and America set out for the Moon and Mars in the fall of 1992.**

The date 12 October 1992 marks the 500th anniversary of the discovery of America by Christopher Columbus. In connection with that anniversary, the United States

has announced an international competition, the Columbus-500, involving the development of spacecraft that, like Columbus's caravels, are powered by the wind. In this case, of course, the wind is not the usual wind—it is the solar wind. About 30 designs were entered in the competition, but there were only three winners—the same number of vessels as in Columbus's expedition. The geography of the victors is also symbolic. Europe, from which the seafarers sailed five centuries ago, is represented by the Soviet design. Asia, to which the travellers sought a route, is represented by Japan. And finally, a space "sailboat" created in the United States will "set out" from America.

The idea of using solar pressure, which was first broached by the Russian scientist Tsander, is almost as old as Tsiolkovskiy's formula. Solar pressure is very weak—in Earth orbit, about a milligram per square meter. To create a force of several grams, a sail the size of several football fields is needed. Is is possible, in theory, to put such a structure into orbit? In the United States, in the 1960s and 1970s, the famous physicist L. Friedman oversaw an intensive study of a design to use a solar sail to fly to Comet Halley. The project was striking for its grandioseness—the sail of the spacecraft reached a diameter of 11 kilometers. In the end, because of technical and financial problems, the design remained unimplemented. But the idea of using the parasitic force of the Sun for economical travel in space remained very tempting....

The main plan for the international expedition is that it be simultaneously a theatrical presentation, a scientific measure, and a sporting competition. According to the conditions of the competition, all designs must be implemented on a nongovernmental basis by volunteer groups of scientists and engineers. There are also technical limitations: no source of energy but solar energy is permitted on board, and the mass of the space sailcraft cannot exceed 500 kilograms. If it is larger, then each extra pound used for expanding the area of the sail or for other engineering strategies will be subject to a large penalty.

The USSR will be represented by the "Space Regatta" project, which is being developed within the walls of the noted "Korolev" design bureau, the Energiya NPO [scientific production association]. The technical director of the project is Doctor of Technical Sciences V. Syromyatnikov, who is the chief designer of the docking systems for manned spacecraft. A "Space Regatta" consortium was created to work on the solar sail spacecraft. The consortium also includes specialists from the Elas, Kvant, and Polyus NPOs, the special design bureau of the Moscow Power-Engineering Institute, the USSR Academy of Sciences Institute of General Physics, and a number of other large organizations. All expenses are expected to be recovered through advertisements and through the sizable cash prize for the winner. The size of the prize varies from $30 million to $200 million, and our designers ambitiously, and with good reason, plan to claim it.

The Soviet space sailcraft will be put into space by a Proton rocket booster. The sails will be tightly packed into special drums and will begin to unfurl once the craft is in orbit. The sails are made of a thin reflecting skin 2-4 microns thick. The diameter of the sail reaches 200 meters, and its area is four hectares. The solar arrays on board enable control of the system of sails, which will be done from the Flight Control Center near Moscow, which we all know from manned flights. The rules call for the drop of a memorial marker onto the Moon—which is mandatory for all of the regatta's participants. Meanwhile, if the race conditions are successfully fulfilled at that point, the race will continue to Mars.

In addition to its participation in the international regatta, the space sailcraft is expected to be used in an original domestic experiment named "Novyy Svet" [New Light]. The essence of that experiment is that from an altitude of 1000 kilometers, where the expedition starts, the deployed sail will throw back to Earth a spot of light reflected from the Sun that is 10 kilometers in diameter. On a cloudless night the illumination from the space mirror will be equal to the brightness of 300 full moons. At that illumination level, one will be able to read and take pictures at night. It would be interesting to consider how our terrestrial life would be changed by a ring of such space mirrors. Energy, agriculture, international cooperation—and all with the ecological purity of a new technology.

How little our problems change over time! Columbus expended more effort in preparing for the expedition and collecting funds than on the journey itself. The same is true today; the matter of the sponsors for the space regatta, who may be inspired by the example of Queen Isabella, remains a difficult one. Our latest idea—to place the solar caravels of all participants into orbit with a Soviet Proton rocket—stems from the same ancient material issues. Whatever the case, the space regatta will begin exactly 500 years after Christopher Columbus set sail from the shores of the Old World.

Soviet-Finnish Project for Commercial Space Exhibit Center

917Q0068 Moscow IZVESTIYA in Russian 9 Mar 91 Union Edition p 5

[Article by V. Konovalov, science reviewer for IZVESTIYA, with a dateline of Helsinki-Moscow: "A Lunar Settlement for Tourists"]

[Text] It seems that the first "lunar settlement" will appear not on the surface of our planet's satellite, but in Finland. That country has a very reasonable approach to space research. The Finns have decided not to train a cosmonaut and not to spend money for prestige only. In Finland they think that it is more reasonable to participate in unmanned programs, including Soviet ones. But that northern country apparently sees its main space specialty as the creation of an amusement-science center intended for tourists and scientists.

Near the large Finnish city of Tampere, a 10-hectare area with a highway and a railway has been selected for the construction of the space center, and design work is proceeding at full speed.

This story began in 1987 when the Finnish journal "Construction Industry" announced a competition for the best design for a lunar base. The most successful design was a joint design by the Finnish architect and builder Pekka Teryavya and the Soviet architect Dzhangar Badmayevich Pyurveyev. The construction of a lunar based according to their original and simple design, if it is done, would be in the next century. That is why the idea came about of creating a "lunar base" on Earth.

The search for a suitable site began two years ago, and it ended in the town of Yulejarvi near Tampere, a large industrial city in the center of Finland. The local community has already leased the selected site for 50 years.

One can already see drawings and models of the future "lunar settlement," and one can take an imaginary excursion there. The center of the "lunar settlement" will be a huge spherical dome 48 meters in diameter. It will rise 30 meters above the Earth's surface. According to the original intent of the authors, the visitors here, after they pass through the entrance hall, are supposed to be included in a space flight program. Several areas are designated for that, and they follow one another in a circle.

The visitors—ranging from children to the elderly—will arrive in groups of about 20. First they are supposed to have a medical examination to evaluate their health. The most suitable candidates for flight will be selected. Then all would, as it were, enter the Cosmonaut Training Center to become acquainted with the simulators. Those who are selected for the flight will don spacesuits and take their place in a three-man spacecraft. The rest will be placed at various "backup" consoles of the Flight Control Center. And then, it's off into space. The equipment makes it possible to simulate a flight around the Earth, to the Moon, and to Mars. After successful completion of the flight, the "cosmonauts" will undergo post-flight examination, and then will meet with those who worried over them in the Flight Control Center around a friendly table, where they will eat actual cosmonaut food from tubes.

The underground portion of the sphere is a large basin around a central elevator with see-through walls. One can observe directly through the glass car of the elevator or through special windows how spacecraft move, how cosmonauts work in weightlessness in water. Here, by the way, actual training sessions can be held. But overall, it is a marine space theater.

Leaving this underground floor in the elevator, one can pass the first floor and exit on the second floor, where various real spacecraft are located. If visitors go even higher in the glass car of the elevator, they find themselves in a green oasis that simulates an extraterrestrial settlement. Here, there are several cafes and bars for those who desire their services. The visitors will experience various psychological methods that relieve fatigue and tension.

Outside, in a semicircle around the central dome is a hotel that accommodates 150 people and in which each room simulates the cabin of a spacecraft. Located on the other side of the dome will be the arc-shaped Service Center building, which will house various space offices and laboratories. International conferences can be held here.

In a forest landscape will be an actual launch pad with a Proton rocket. Nearby will be an area with various attractions and an exhibition of space technology from around the world.

The development, which is headed on the Soviet side by Professor D. B. Pyureyev, consists of a large group of our architects and space specialists from scientific institutes and industrial enterprises. Much of the equipment for the "extraplanetary center" in Finland will be copied from actual Soviet space hardware.

Pekka Teryavya, the director and manager of the joint-stock society called the Teryavya Group, is full of enthusiasm. In his 52 years, he has designed many homes and public buildings, including vacation and tourism centers in Spain, Italy, Morocco, Tunis, the Soviet Union, Mongolia, and China. But he considers all that only a prelude to the main concern of his life—the space tourism center. He thinks that the first phase of work will be put into commission in 1992, which marks the International Space Year. It is not a dream, but a judicious calculation.

To implement the project, a jount Soviet-Finnish venture—Kosmos-Luna [Space-Moon]—has been organized with USSR Glavkosmos [USSR Main Space Administration] and the support of the USSR State Committee for Science and Technology. Sixty percent of the corporate capital, and that means 60 percent of the future revenues, goes to the Soviet side. The proposed expenditures are not that large—about $70 million. That is how much the United States would take to fly three foreign cosmonauts on board the space shuttle. But this center could be visited by about 500,000 children and adults a year.

We hope that such a center will also appear in the Soviet Union. If our enterprises, in the midst of conversion, get actively involved in the manufacture of the needed equipment, it could be delivered to all countries of the world for lunar settlements on Earth.

Omsk Production Association 'Polet' Advertises Capabilities, Seeks Customers

917Q0072 Moscow SOVETSKAYA ROSSIYA in Russian 20 Mar 91 First Edition p 4

[Advertisement for Omsk Production Association 'Polet' in SOVETSKAYA ROSSIYA]

[Text]

Polet Production Association

The Polet Association is a large aerospace enterprise that produces a broad range of products—from space vehicles to consumer goods.

On its premises are an experimental design bureau, a scientific research manufacturing institute, an institute for the design of industrial enterprises, an institute for training engineers, and an aviation technikum.

The production and technical experience of the association's personnel represent priceless capital garnered over a period of 50 years.

Polet Production Association Celebrates 50 Years.

In July of this year, the Omsk Polet Production Association marked its anniversary. In 1941, an aviation plant was created on the basid of three Moscow plants that had been evacuated to Siberia. It was housed at the time in several converted and hastily constructed buildings.

Over the years gone by, the plant has grown many times over in terms of its scale of production, and it occupies a total area of 15 square kilometers. It has united many thousands of workers and specialists into a single collective.

From a specialized aviation construction enterprise, Polet has grown into a multi-purpose association that, in addition to fundamental space products, produces a large assortment of consumer goods (such as Sibir washing machines and toys) and civilian products (diesel fuel separators, medical equipment, etc.).

Many important and complex problems have been solved by the association's collective over the last 50 years. Here are only some of them:

—production of the YaK-7 and YaK-9 fighter planes was mastered in five months. In two and a half years, a total of 3,405 fighters were produced

—the production of the IL-28 bomber was set up in nine months. A total of 758 aircraft were produced for the Soviet Army

—the production of the TU-104 passenger airliner was mastered in 12 months. Fifty-eight aircraft were produced

—production of space hardware has been mastered on extremely short deadlines

Of course, that could be done only by selfless, creative people devoted to their work. And they worked not out of fear, but out of conscience.

Last year, the Polet personnel again proved that they knew how to work creatively. With a reduction in defense orders, they were enterprising enough to boost the volume of consumer goods produced by 65 percent, that is, the production of consumer goods was 42 million rubles higher than in 1989.

Today, with the multi-purpose aircraft for the Arctic, the AN-74, being put into production, the problems that are coming up are the same one that came up 50 years ago—production must be started for a new product and its quality certified in compressed time frames. And that must be done in the midst of disorder, when economic ties have been disrupted and suppliers have been lost. But before, in even worse conditions, each found within himself the strength to work and not groan about the difficulties. Everyone is certain that the Polet production association will be able to solve this difficult problem by using the experience of veterans, the best work traditions and habits, and determination.

The personnel of Polet hold dear their recollections of the legendary historical figures who created the fame of Soviet aviation and the Soviet space program. A. N. Tupolev and S. P. Korolev worked at the Omsk Aviation Plant.

The council of veterans of the association is addressing the readers of SOVETSKAYA ROSSIYA when it says we will be grateful to all who worked at the Polet production association earlier or who worked with S. P. Korolev and A. N. Tupolev and who are prepared to share documentation and recollections.

We invite all of you, dear veterans, to the anniversary of our association.

We hope to see in the pages of this newspaper sketches on other enterprises whose work created the history of aircraft and rocket construction.

The Past

July 1941—the year the aviation plant was set up in Omsk.

December 1941—the first TU-2 high-speed dive bomber is assembled and manufactured in the shops of the plant.

December 1942—production of the YaK-7 and YaK-9 fighters is mastered.

1949—the first IL-28 bomber.

1957—manufacture of the first TU-104 passenger jet airliner.

1969—development of the Kosmos series launch vehicle.

January 1974—production and launch of the first high-altitude atmospheric probe, the MIR-2 rocket-space complex of the USSR Academy of Science and the organization of Interkosmos.

1984—participation in the manufacture of the propulsion system for the Energiya launch vehicle.

1985—manufacture of the 5,000,000-th Sibir-6 washing machine.

1988—participation in the launch of the Buran spacecraft by the Energiya launch vehicle.

1991—beginning of work on mastering production of the AN-74 multi-purpose aircraft.

Polet has to its credit more than 40 programs of international cooperation under the aegis of Interkosmos, KOSPAS-SARSAT, and bilateral agreements including the production of the Indian satellites Aryabhata, Bhaskara-1, and Bhaskara-2, the French Sneg system, and work involving domestic research in the development of space.

A significant role is played by the control method which has been chosen: the separation of production, an increase in the independence of departments, and the selection of specialists and partners.

Polet products are of high quality and advanced technological design.

The Polet association is 50 years old, but its skilled personnel and latest technologies make it development vigorous and give it a sense of purpose.

The Present

Polet is an enterprise for the production of space equipment: launch vehicles, propulsion systems, commercial communications and navigation satellites.

Polet is the organization of a joint-stock enterprise for medical equipment.

Polet produces a wide range of goods for the consumer, with a production volume of over 120 million rubles.

Polet is an enterprise which has its own airport with a reinforced concrete takeoff and landing strip that is 3,100 meters long and is capable of receiving and servicing transport aircraft of any class.

Polet stands for goal-oriented social programs: Annual construction of over 50,000 square meters of living quarters; an enclosed stadium; vacation facilities on the Black Sea, in Kazakhstan, and on the banks of the Irtysh River; improvement of the life and recreation of workers.

Polet is the implementation of "hundreds of initiatives" of modern entrepreneurship.

The Future

Polet is the initiator and cofounder of an international innovative joint venture, KOSKON, which implements programs to create commercial communications space systems.

Polet is a participant in meetings and negotiations with representatives of foreign firms on a number of projects to organize joint production of high-tech products.

Polet is an enterprise which is mastering the production of the AN-74 multi-purpose aircraft.

Polet is a partner with the French firm "Tomson Electromenage" in the manufacture of modern automatic washing machines in the "Tempol" joint venture.

Mastering the production of the new model AN-74 aircraft requires advanced technology, new approaches to control, and young creative personnel.

We take the opportunity to invite leading specialists in the production of aircraft in the posts of chief engineer and chief designer to participate in a competition with Polet personnel with the presentation of all social guarantees to the winners.

We Are Ready To Work With You

Conversion. Many hopes rest on it. It has enabled us to use the scientific, technical, and production potential that we have garnered for the economy for humanitarian purposes.

Soviet and foreign partners can USE THE ROCKET-SPACE COMPLEX based on a launch vehicle that is manufactured by the enterprise and that will put YOUR spacecraft or a customer's equipment installed on a vehicle into orbit. We will provide day-to-day monitoring and control of the satellite at all stages of its life and operation.

Using a satellite, YOU can create various telecommunications systems and systems for rescue and emergency communications and can provide communications with hard-to-get-to regions of the country or with geological crews. You can expedite the movement of large tonnage containers and trains carrying your especially important cargo.

In addition to its principal products, Polet produces goods which are in great demand: kitchen cabinets, kitchen furnishings, electric appliances (including the popular semiautomatic Sibir washing machine), children's toys, and other goods.

Among the recent innovations of the enterprise is an automatic line for the production of 1,200 eclair pastries per hour, an electric cream separator, and a grain mill.

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1. In the creation of joint productions and joint ventures, we have a production capacity for foundry work, forging, sheet-metal stamping, and cryogenic work used in manufacturing the following:

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—machine-tool parts (including for forging and stamping pressed-forged products);

—advanced industrial and general welding equipment for high-frequency-current welding when the Soviet or foreign partner has high-frequency thyristors and diodes and high-voltage filtering capacitors;

—cryogenic materials (compressed nitrogen and oxygen), plus the use of them.

2. You can use our experience in the scientific and technical field to create a center for the sale and introduction of original designs, patents, and licensing.

3. In mutually beneficial conditions, we are ready to work with enterprises that produce the following: sheet steel, nonferrous rolled products, plastics, polyethylenes, polystyrenes, lumber, and KD-10, AVE-071, DAOU, and KD-120-2ET electrical motors.

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Gorbachev Speech on Gagarin Flight Anniversary

LD1004172791 Moscow Central Television First Program Network in Russian 1355 GMT 10 Apr 91

[Speech by USSR President Mikhail Gorbachev at a meeting held in the Hall of Columns in the House of the Union in Moscow, marking the 30th anniversary of Yuriy Gagarin's space flight—live]

[Text] Dear comrades, esteemed guests. We have gathered here to mark an outstanding event in the life of our country, and without any kind of exaggeration, in the history of mankind's entire civilization. Thirty years ago on a spring day in April, a citizen of the Soviet Union, military pilot Yuriy Alekseyevich Gagarin, opened up the epoch of man's flights in space. The history of Gagarin's personal feat can be set out in just two to three phrases: a working boy from the Russian Non-Chernozem Zone becomes a first-class pilot; masters the newest, highest world-standard equipment. From the Baykonur cosmodrome, built on the expanses of Soviet Kazakhstan, he is the first to lift off to an unprecedented height over the Earth, flying around it in just 108 minutes.

This event, which many at the time considered to be a Russian miracle, became in actual fact a natural continuation of the flight of the creative thought of Tsiolkovskiy, Korolev, Keldysh, and many other outstanding fatherland scientists and designers. This was also the result of the indefatigable inventive work of hundreds of thousands of engineers, technicians, workers, and specialists from practically all branches of knowledge.

Gagarin's flight turned into one of the greatest feats of our multinational Soviet people. It is doubly fitting to recall this today, for we—however much somebody might want it—cannot become like Ivan the Forgetful. Faith in the strength of the people of a great country, the spirit of patriotism, grateful memory of those who created the might and glory of the fatherland are not for anyone to cross out.

Soviet space research remains a fusion of science, technology, and industry, enjoying world recognition. Great thanks are due to all those who are involved in the development of this leading area of the country's scientific and technical progress. Particular gratitude is due to the whole detachment of cosmonauts for whom there is no room on the Presidium. Health and courage to each of you, dear comrades. We warmly congratulate your wives, your families and all of your relatives and friends. I hope that our good wishes for a successful flight will also reach Viktor Afanasyev and Musa Manarov, who are currently performing their watch in Earth orbit. May they hear the warm greetings from this festive hall. The most sincere words of gratitude are due to the remarkable veterans of space rocket technology—I met many of them here just now, just before the opening—and I was glad to see them healthy, and taking an active part in this festive meeting.

The achievements of space research have firmly entered our everyday lives. These include space communications and television systems, the use of space equipment in land surveying, geology, meteorology, navigation. The present and future of space research means the latest technology for obtaining new medical preparations, ultra-pure materials for electronics, composite materials, ecological monitoring, the elaboration of new principles in using solar energy, and much, much more. The successes of space research, and the beneficial yield which they bring in various spheres of the national economy are the fruits of cooperation and the common asset of all the republics, all the peoples of our Soviet Union.

As president of the Soviet Union I have to stress in particular the great contribution by space research to the reliable defense of the country, to monitoring the fulfillment of international agreements on arms cuts and confidence-building measures. Our space science and technology is, as never before, now wide open for international cooperation. The Soviet Union favors access for all countries to space information under the aegis of the United Nations, and is ready to make its resources available for this.

We favor continuing the development of joint space research with the United States, with European countries, China, India, and Japan, literally with all interested states and organizations. In this connection I warmly and cordially welcome the cosmonauts and astronauts present who have come to our celebrations from many foreign countries.

The prospects of international cooperation are mutually favorable, especially in connection with the conversion of the huge intellectual and production potential of a number of leading sectors of our defense complex. It is sufficient to speak, for instance, of the possibilities of the joint use with foreign partners, of space platforms for reliable and universally accessible telephone and radio communications, and of universal information systems

which can be created with the help of the unique-capacity, ecologically clean Energiya rocket.

On the eve of International Space Day I wish to express the confidence that the space science, technology, and industry of the Soviet Union, given the necessary state and public support, will be able, in conditions of peace, to bring our people, and not only them, more and more tangible and useful results in all spheres of human life.

Allow me to consider this festive meeting of scientists, designers, workers, military experts, cosmonauts and astronauts, devoted to the 30th anniversary of the space flight of Yuriy Alekseyevich Gagarin, as open.

PRAVDA on Gorbachev Speech at Gagarin Meeting

PM1204104291 Moscow PRAVDA in Russian 12 Apr 91 First Edition pp 1-2

[Report by TASS correspondents V. Bezbrezhnyy and N. Zheleznov: "Union of Reason and Accord: Ceremonial Meeting in Moscow"]

[Excerpts] The people who came to the Hall of Columns of the House of the Unions on 10 April to commemorate the 30th anniversary of Yuriy Gagarin's space flight did not hide their pride in and admiration for the selflessness of the pioneers of space. The audience included those who built the space center, designers of space equipment, workers and engineers from space industry enterprises, Soviet cosmonauts, and foreign guests. M.S. Gorbachev, USSR president, A.I. Lukyanov, chairman of the USSR Supreme Soviet, and V.S. Pavlov, USSR prime minister, were in the meeting's presidium.

The opening address was delivered by M.S. Gorbachev. He said:

We have gathered here to mark an outstanding event in our country's life and, it is no exaggeration to say, the history of all human civilization.

On a spring day in April 30 years ago Yuriy Alekseyevich Gagarin, a citizen of the Soviet Union, opened the era of manned space flight.

The story of Gagarin's personal exploit may be set out in two or three sentences: A working boy from Russia's Nonchernozem Zone, he became a first-class pilot. He mastered the latest equipment of the highest world standard. And from the Baykonur space center built in the expanses of Soviet Kazakhstan he was the first to lift off to an unprecedented altitude above the earth which he orbited in just 108 minutes.

This event, which many people then considered a "Russian miracle," was indeed the logical continuation of the creative thought of Tsiolkovskiy, Korolev, Keldysh, and many other outstanding Soviet scientists and designers. This was also the result of the tireless inventive work of tens and hundreds of thousands of engineers, technicians, workers, and specialists in virtually all spheres of knowledge....

Gagarin's flight embodied one of the greatest feats of our entire multinational Soviet people. It is doubly appropriate to recall that here today. Because no matter how much some people might want, we cannot be like "Ivan the Forgetful." No one can cancel out the faith in the strength of the people of a great country, spirit of patriotism, or noble memory of those who created the fatherland's might and glory!

Soviet space research remains a universally recognized fusion of science, technology, and industry. Many thanks to all who are involved in the development of this leading area of the country's scientific and technical progress!

The motherland's special gratitude goes to the entire detachment of spacemen. Health and courage to each of you, dear comrades! I warmly congratulate your wives, your families, and all your relatives and friends on Cosmonaut Day!

I hope that our good wishes will also reach Viktor Afanasyev and Musa Manarov who are today keeping watch in near-earth orbit. May they hear the greetings from this ceremonial hall....

The successes of space research and the useful return which it brings to various spheres of the national economy are the product of cooperation and the common asset of all the republics and all the peoples of our Soviet Union.

As USSR president I must stress in particular the great contribution of space research to the reliable defense of the country and the monitoring of the fulfillment of international agreements on arms reduction and confidence-building measures.

Our space science and technology is now more wide open than ever before to international cooperation. The Soviet Union favors access for all countries to space information under UN auspices and is ready to make its resources available for that.

We support the continuation and development of joint space research with the United States, European countries, China, India, and Japan and literally all interested states and organizations.

In this connection I warmly and cordially congratulate the cosmonauts and astronauts here who have come to our celebrations from many foreign countries!

The prospects for international cooperation are mutually beneficial. Particularly in connection with the conversion of the vast intellectual and production potential of a number of leading sectors of our defense complex...

On the eve of International Space Year I would like to express the confidence that Soviet space science, technology, and industry, with the necessary state and public support and working in conditions of peace, will be able to bring our people—and not just them—increasingly tangible and useful results in all spheres of human life. [passage omitted]

In conclusion, Yu.D. Maslyukov, USSR deputy prime minister, who is chairing the meeting, once more expressed congratulations on the celebration to all those who by their labor have created space equipment and increased the fatherland's glory.

Press Conference on 30th Anniversary of Gagarin Flight, Drop in Space Budget Noted

LD0904221791 Moscow TASS in English 1718 GMT 9 Apr 91

[By TASS correspondent Rena Kuznetsova]

[Text] Moscow April 9 TASS—The planet's first cosmonaut Yuriy Gagarin dreamed that outer space would serve vital interests of people, peace, progress and cooperation between all peoples.

A news conference devoted to the 30th anniversary of Gagarin's space flight at the Soviet Foreign Ministry press center today reflected a common understanding that his dreams were coming true.

Speakers said the world celebrated April 12, the date of Gagarin's flight, as the world day of aviation and cosmonautics. After Gagarin's flight, 245 cosmonauts and astronauts made space flights, including 69 Soviet cosmonauts.

"We intend to build space production complexes to carry out a large-scale program in the interests of various branches of the national economy," said chief designer of the Association Energiya Yuriy Semenov.

He said that one of the tasks of the Soviet cosmonautics is to implement a space exploration program at the orbital space complex Mir.

The station is now being operated by Viktor Afanasyev and Musa Manarov.

Semenov denounced appeals to curtail space programs because of economic difficulties in the country. "I am sure this is a wrong and incompetent opinion," he said.

Oleg Shishkin, the Soviet minister of general machine-building, told the news conference that the Soviet Union and the United States should pool efforts in exploring and conquering outer space.

He said that state subsidies for the Soviet space exploration program were constantly decreasing. In 1989, the government allocated 6.9 billion Roubles for this purpose and in 1991 the sum shrank to 6.3 billion Roubles.

Vladimir Shatalov, the head of the Cosmonaut Training Center, said that a space ship with a Soviet-British crew was scheduled to blast off on May 12, 1991.

The Soviet space agency is planning joint space flights with Austrian, German and French cosmonauts this year and is now negotiating a joint flight with U.S. partners.

Two Views on Value, Effectiveness of Space Program

917Q0075 Moscow TRUD in Russian 5 Apr 91 p 4

[Article by B. Olesyuk, specialist at the Center for Flight Control, and B. Chertok, corresponding member of the USSR Academy of Sciences and deputy general designer of the Energiya Scientific Production Association: "Cosmic Heights and Gaping Abysses—Two Views on the Development of Cosmonautics"]

[Text] **On 12 March it will be 30 years since that happy day when Yuriy Gagarin was the first person from earth to fly in space. This was a truly historic event which opened up to mankind the path beyond the confines of our planet. Thirty years is a "round" figure. It is time for us to look back and see: How have we managed to advance along this path, what have we done and what have we not managed to do, and have we always been true to our intentions? TRUD is offering the readers the opportunity to learn about two largely opposing views of the development of space science. Two views, two fragments from a multicolored mosaic of opinions. An occasion for reflection... But this subject is inexhaustible.**

"In an Unnecessary Race for Prestige"

By B. Olesyuk

Yu.A. Gagarin's flight was a triumphant victory for mankind, his thought, and his talent over the force of gravity. But the breakthrough into space was not solely for the purpose of demonstrating this. To open up to man new secrets of nature and the universe and to produce considerable advantage in concrete, practical affairs—these are the goals of space science. And we have managed to do a good deal in this direction—both in our country and abroad. But a great deal has also been left undone, a good deal of energy and money has been spent inefficiently and sometimes for no purpose—out of considerations of prestige, the battle of ambitions, the rivalry of design bureaus and designers, and the sometimes incorrectly selected goals and strategic tasks.

I will express my own personal opinion, with which, possibly, not all of my colleagues will agree. I will give one clear example. The Americans have created a variety of space ships whose launching and operation costs somewhat more than it costs to launch single-launch rockets. Out of prestige considerations, we have decided to do the same thing: Spending more than 15 billion rubles [R], we built the Buran, but now we do not know what to do with it or how to use it.

In general, until recently we spared no expense—the money flowed, as they say, like water.

There were more and more new launches, in many cases not for the sake of improving the life of the people but in the name of the prestige of a country of "developed socialism." The program was basically purely propagandistic in nature and was divorced from the crucial tasks of the economy and frequently from fundamental science as well.

Soon a label was attached to the program for manned flights—"international." Our country's kind leaders, mindlessly handing out billions of rubles of the people's money, also gave them expensive space gifts: Almost free of charge, they took all comers for a ride in space. (The cost of the imported equipment was incommensurate with the overall expenditures.) Before the Soviet-Japanese flight, which was conducted for the first time on a commercial basis, 15 representatives of various countries had spent time in orbit on Soviet space equipment.

I will give a couple of figures related to this. A space flight with a man on board is a very costly undertaking. It is approximately 10 times more expensive than an unmanned flight if one calculates according to kilograms of useful load. Yet specialists obtain basic information from space about our planet and distant stars from satellites. The satellites do an excellent job with all the tasks set on this plane.

Let us return to expenditures again. The flight of one cosmonaut on the Mir station for one hour (!) costs R50,000. A day's flight costs R1.2 million. If you multiply this figure by the number of days in a year, it is easy to imagine approximately how much it cost to keep V. Titov and M. Manarov in space for just one year.

And another thing. The training of one foreign cosmonaut costs R2.6 million, and one Soviet—R1.3 million. And expenditures on ground equipment are also considerable—R10 million for the spaceship Soyuz TM.

And the return? But that, apparently, has not been the main thing. Economic interest was sacrificed for political competitiveness. And was only with the launching of the Mir station did we seem to awaken, remember the economic side of the matter, and begin to think in different categories. To put it simply, we began to keep track of money. We began, but we did not learn how.

A third-generation Mir station has been traveling the earth's orbit for six years now. But the national economic effect from the implementation of the complicated and costly Mir program, hard as it is to admit it, was nil. The immense amount of money did not produce any kind of advantage for the national economy. And God only knows how many billion the program "ate up." In any case this information has not been made public yet.

As a rule, our space expenditures are kept secret. There is no organ which could translate space achievements into the national economy. On the other hand, our antimarket economy in general is **unreceptive to scientific and technical progress.**

During the past five years, taking our space science as a whole, not a single space program has been fulfilled completely. Even the Mir program is on the verge of failure. What are the reasons?

In the first place, we have not yet managed to find an optimal, reasonable ratio between manned and automated space projects. As was already said, the lion's share of the scientific and practical tasks (and for national economic tasks—the whole 100 percent) could be carried out with automated equipment. But in our drive for prestige and spectacular achievements in space we assigned inappropriate functions to the Mir station.

For example, when conducting astrophysical experiments the Mir complex requires permanent orientation, and very precise orientation at that. With people on board it is impossible to meet this requirement (the movement of the cosmonauts has a negative effect on the orbital complex). Experience shows that extraterrestrial observatories can conduct these investigations without man.

In the second place, micro-accelerations also impede space technology: obtaining crystals and other materials. Increasing the number of attached elements degrades the resistance and dynamic characteristics of the Mir multiblock system. In particular, the top of the Kristall module rolls from side to side (like the spire of the Ostankino tower in the wind), especially when the cosmonaut is on the treadmill.

But even those semiconductor materials obtained in the electric warming furnaces of the Kristall module—where are they? Show me even one computer in which these crystals are used...

So far we know that the situation in the Mir "metallurgical shop" is pathetic. Of the five smelting furnaces only one more or less works and the rest "are on their last legs." The cosmonauts repair them and then they break down again.... Many of our problems on the Mir are caused by the poor quality of the electronic equipment.

In the third place, there is a shortage of electric energy. The Kristall module has five smelting installations, but because of the shortage of electric power no more than two can be turned on at the same time.

In the fourth place, there is the problem of increasing the size of the crew. Since immense sums have already been spent on creating Mir, and the station is in orbit, we must be concerned about its effective utilization. Now this will be less expensive than it would be to create new satellites and put the station in mothballs. With Mir it would be possible to conduct an important ecology program and solve a number of other problems. But for effective use of the complex and for real work on Mir even now it is necessary to have a crew of six people.

It turns out that today this is not possible, even though Mir was intended for six to 10 cosmonauts. Only two are working on it. Why? The spaceship Soyuz can carry a maximum of three people. But then it is impossible to bring anything back from orbit when it returns. So two people fly in it. And a second ship cannot be sent: There will not be a free docking facility for it for a long time since they are always having to make room from the Progress cargo spaceship bringing supplies of food, water, and other things. So there can be only weekly "guest" flights to the main expedition, but they are completely ineffective.

So that is the sad picture. In this connection a question arises: Did we need the Mir at all? I will answer this way: We undoubtedly needed it. Only for different purposes and tasks.

I have discussed only one example of the mistakes related to the Mir station. We have made many even more glaring mistakes in our space science. While recognizing its achievements (and they are undoubtedly considerable), on the threshold of its anniversary I would still like to concentrate attention on its shortcomings, for the burden of these is becoming excessively heavy—too much for our economy.

Space science is a very promising branch and it should do a very great deal for the country, the more so since we have a good foundation. This is precisely why we must have a well-thought-out strategy and tactics here.

Expenditures Could Be Recouped Ten-Fold
By B. Chertok

There are events which leave a special mark on people's memory and history, and they are a powerful impetus for the rallying of the people, the appearance of a kind of emotional upsurge that unites society and cements it together. The first flight of man in space, that of Yuriy Gagarin, was such an event.

Today the country is divided and the people are hostile and worked up. Yes, we have many problems now. And they can be solved only by working and consolidating society for the sake of what nations and people have in common. One of these goals, in my view, is space science—that global field to which we must apply the energy, intelligence, and creativity of millions.

Let us recall how, in response to our achievements, the Americans developed the program for a manned expedition to the moon. This program was realized brilliantly.

And we have seen that man's participation in the societies that carried out such grand projects as the first space flight and the first landing on the moon awakens feelings of national pride, of one's own worth, and of universal solidarity. This was manifested fully both in the USSR and the United States.

The launching of space equipment to investigate the atmosphere, the solar system, and now even its limits, has led to many fundamental discoveries, and space systems are capable of developing new branches of an effective economy, without which progress in the national economy is impossible (television, telephone, and other communications and the weather service are unthinkable without satellites).

But today it is not creativity but the chaos of destruction that threatens to swallow up society. And space science does not escape this. We must get space projects off the ground and insist on an immediate economic return from assimilating space that exceed expenditures on space science many times over. They say that 6.9 billion rubles [R] "for space" is extravagant. But almost two-thirds of this money was used for military applications in space. Or do problems of protecting the homeland not interest us any more? The war in the Persian Gulf has shown that we are still a long way from complete harmony in the world... And what are R6.9 billion spent on space when unproductive expenditures and direct losses in the USSR national economy in that same year of 1988 amounted to hundreds of billions.

On the other hand, space science is a basic science. And as with all other basic research, one cannot count on an immediate return from funds invested in it. So far a large amount of work has been stockpiled. A new environment for mankind is being assimilated—space (and along with this, its possibilities are being utilized with ever increasing effectiveness). Or do we intend to live for today without putting anything aside for tomorrow? In this connection one recalls Yuriy Gagarin's excellent statement: If throughout our history mankind had been guided only by immediate advantages and aspirations, we would be living like cavemen to this day.

Of course, in the assimilation of space money must be invested with intelligence and maximum effectiveness—nobody would argue with that. Alas, we have not managed to avoid mistakes here. But with hindsight it is not difficult to point out mistakes and failures. They are on the surface. When doing a large amount of work it is impossible to avoid them. But all this certainly does not mean that the development of Soviet space science was a long series of mistakes.

In this connection I would especially like to deal with an issue that is being discussed extensively today: Why did we spend so much money on the Energiya-Buran system? I will answer like this: This work was by no means done for considerations of prestige and not at the whim of the leaders of the military and industrial complex. One can argue about how effective and competitive this system is compared to others like it. Even the Americans, who have achieved undoubted success in the operation of the multiple use space shuttle system, have various viewpoints regarding this. But the beginning of the creation of a similar system in our country, following the Americans who took the lead, was brought about by the possible and quite real threat at the time that the space shuttle aircraft would be used for military purposes. The desire to have military and technical parity during the Cold War

required the creation of a similar system. This was the origin of the idea of the Buran in 1974.

At the same time the desire to combine the qualities of rocket- space equipment and the aircraft into a single system is an unconditional and predictable requirement of the time. Many countries, following the example of the USSR and United States, are working most actively on the development of "cruise" manned spaceships—multiple use air-space systems. What is this—a misunderstanding, repetition of "mistakes"? One could hardly agree with such a conclusion.

Unlike the American space shuttle, our Energiya booster rocket is capable of taking a multifunctional communications satellite weighing 18 tons into geostationary orbit. All other carriers, including the American and French, are still unable to deliver equipment weighing more than 2.7 tons into this orbit. There are difficulties not only in delivering an ultra heavy satellite but also in providing for normal operation for a long period of time. We have both the Energiya booster rocket and experience in creating large elements and control and stabilization systems accumulated during the development and operation of the Mir complex.

A system based on satellites like this will make it possible to fully satisfy the country's demands for main telephone communications channels before the year 2000. There will be communications among many thousands of rural villages and for regions which are hard to get to and far away (we have fallen decades behind the developed countries in this). The republics will receive multichannel and multifunctional intrazonal and local communications and access to international communications channels. Each region of the country will realize the possibility of receiving directly, using antennas from 0.9 to 1.5 meters in diameter, no less than four Union channels and two to three regional ones.

The plans for such a system, which creates a new communications infrastructure by taking advantage of the unique possibilities of the Energiya booster rocket and the scientific and technical stockpile from the Mir complex, provide only one example of how the funds spent on manned systems produce a significant effect.

Returning to the discussion of mistakes, one cannot but admit that there were mistakes and failures, particularly in the creation of the Mir orbital complex. But on the whole many problems were solved here which seemed almost impossible before the complex went into operation. Among other things, the problem of man's spending more than a year in space was solved. The reliability of closed life support systems was proved. The problem of obtaining electric energy from the sun was solved successfully. And the very fact that the orbital station has been in operation for five years without major emergencies and that Soviet crews have been constantly present and constantly working in space are one of the achievements of which our country has a right to be proud.

Costly? Yes, in 1990 the operation of Mir cost R1 million a day and not more than 400 million in 12 months. But this is approximately one-tenth of our losses from crops during that same year of 1990....

And, finally, a couple of words about the so-called indirect return from space science for the national economy. The transfer of experience and achievements to other branches, which could repay expenditures tenfold, now that all secrecy restrictions have been removed, is proceeding extremely slowly—one might say like pulling teeth. There is no economic incentive. This is a problem for our entire system and space science is not to blame.

But we have something to give the national economy. When creating that same Energiya-Buran system we completed about 600 significant technological developments. Their assimilation will more than pay for expenditures on creating the system, even if we never launched it into space...

One can only regret that the immense scientific and technical potential created by space science is frequently left unclaimed.

'Buran' Designer Semenov Discusses Program, Future Projects

LD1304170491 Moscow Central Television First Program Network in Russian 1615 GMT 12 Apr 91

[Interview with Yuriy Pavlovich Semenov, chief designer of the "Buran" spacecraft, by unidentified correspondent; place and date not given; from the "Gagarin Television Festival" program—recorded]

[Excerpts] [Announcer] At the end of the 80's, calling ourselves a superpower and having built a gigantic industrial- bureaucratic structure and having succeeded almost totally in debunking it with a realistic realization of our place in the world, we again made a spurt ahead of the whole planet: the "Energiya" rocket with the "Buran" reusable spacecraft was launched. [passage omitted]

Many experts have doubts about the desirability of using our reusable system for the conquest of space. Will the giant 100-tonne "Buran" find a use in orbit? Was the money thrown down the drain? Given such questions, the position of the presenter, Chief Designer, Yuriy Pavlovich Semenov, is quite explicable:

[Begin Semenov recording] My view is that "Energiya" and "Buran" are the acme and triumph of all manned cosmonautics, whatever might be said by anybody. Today, we have a complex possessed by no other country in the world. The fact that there are attempts to criticize us is based on a simple misunderstanding. It belongs to the whole people. More than 1,200 organizations took part in the "Energiya-Buran" project. If you talk in numbers, this was 3 million people. [passage omitted]

To answer your question about what our position is today, I can say without any exaggeration that we continue to have the lead in the world today. There's no exaggeration in that. [end recording]

[Announcer] It can be no bad thing when the chief designer gives such a high and categorical appraisal of his own work:

[Begin recording] [Correspondent] Why is the "Energiya-Buran" system still not working fully, at full stretch?

[Semenov] I can tell you that with "Buran" we were a little ahead of events. That means that "Buran" is a machine. First of all, I have to say frankly that "Buran" was developed to counter the Shuttle. It's only now that everyone, including Marshal Yazov, is repudiating it: they say "Buran" is unnecessary. But, I remember lectures back in the 70's, when it was explained that [?the Shuttle] can make a pass over Moscow on a return maneuver. We had gotten used to the idea of what it could do, and they were talking to us from a position of strength.

[Correspondent] So, "Buran" was ordered by the defense ministry?

[Semenov] The project was originated by the Defense Ministry, although they are now disowning it. All this took place before my very eyes. It was designed to counter or parry, as it were, the work that was being done in the United States [words indistinct]. The United States followed a false trail. They use the shuttle as their main launch vehicle. They have now had second thoughts. It's costing them a pretty penny. They've only put up several large objects which really merited the use of the shuttle, as had been planned. We took another route and use "Buran"—and plan to continue to do so—where it is indispensable. For example, I cannot see today that the Mir station has any prospect of development without "Buran". That is, some time in 1994 Buran is to go up and reconfigure the "Mir" station, renew certain modules and revise the uses to which "Mir," as a factory for the production of materials and biological compounds, is put, attach modules and return them to Earth. Those are "Buran's" real tasks. But, simply to put satellites into orbit, as the shuttle does, this is very costly. [passage omitted]

"Energiya" can be used with success for assembling large orbiting complexes [words indistinct]. We have experience of docking. We can add bits on, and we effectively have unlimited possibilities. As far as a flight to Mars is concerned, our estimate is 450-500 tonnes. But, we don't necessarily have to develop a 500-tonne carrier rocket. We can achieve the same result by adding on four or five bits. So, we've solved the problem. The United States doesn't have this. There's also the question of a lunar base, if we are to have one. Incidentally, we are inviting them to take part in joint work. There's the Mars program.

"Energiya" ushers in a completely and qualitatively new stage in the field of communications and television and radio broadcasting. I refer to the development of large, heavy standardized platforms on geostationary orbit, platforms which are high powered and require large antenna facilities, multiwire antennas. It is only by means of platforms such as this that our problem of communications and television and radio broadcasting can be fundamentally solved. It has been shown, and not just by our own collective of experts, but practically everyone was involved, including the Institute of Communications, that three such platforms are equivalent to putting in orbit about 40-50 Proton-class satellites. It's not a trolleycar, where you can get on, elbow your way through the crowd, and find a place. The problem today is overpopulation in geostationary orbit. These platforms are the only sensible way to tackle this problem of ours. Small satellites should continue to exist, but they do not solve the problem. Did you know that something like 4-6 such platforms could resolve the global problem of communications and radio broadcasting altogether? In my view, if we spend something like R15-17 billion on this system overall, along with the ground communications—our estimate is R13-17 billion—by the year 2000, if we develop this by 1995, we will get something like R39 billion or R37 billion on the return it will yield, from providing services, and so on. We should not forget that any developed country that wants to double its gross product has to think of quadrupling rapidly the amount of information circulating in society. [passage omitted] [end recording]

State Committee Chairman Kerimov on Future Prospects

AU2304083591 Budapest NEPSZABADSAG in Hungarian 20 Apr 91 p 25

[Interview with K.A. Kerimov, chairman of the Soviet State Committee in Charge of Manned Space Flights, by Andras Desi; in Budapest, date not given: "An 'Eminence Grise' of Soviet Space Research: We Should Stretch as Far as...."—first paragraph is NEPSZABADSAG introduction]

[Text] We do not expect a sudden development in space research until the end of the century, a development similar to the one that took place in the past decades; in addition to the Mir program, Soviet space research will concentrate on helping solve the prevailing ecological problems—A.K. Kerimov pointed out in an interview he granted to NEPSZABADSAG during his visit to Hungary on the occasion of a festivity organized in memory of the first astronaut. This "eminence grise" of Soviet space research—the invisible person whom the returning Soviet cosmonauts report to—also participated in the preparations of Yuriy Gagarin's space flight.

[Desi] The Soviet Union lately seems to be displaying passivity in the space race, while the Americans have outdistanced you....

[Kerimov] There has been a competition in space research since we launched the first sputnik. We regularly took the lead in the years following this first success, but I would like to remind you of the words of the late U.S. President Kennedy: In the long run, the U.S. economy will prove to be much stronger.

The Americans like spectacular things, and I do not mean this in a pejorative sense. This also applies to space research. Obviously, landing on the moon was a great thing, but the fact that we also landed on the moon—albeit with an automatic probe—received much less publicity. Our landing was cheaper and also less dangerous.

[Desi] Do you regard the U.S. space shuttle program as another such "spectacular thing?"

[Kerimov] The U.S. space shuttle program is fascinating, especially from the viewpoint of the actual transport capacity of 20 tonnes! This is fantastic! However, concerning the amount of work carried out, the Soviet Mir space station is much more efficient because it is constantly deployed in outer space. The U.S. space shuttle takes off for about one week at a time, and then it "rests" for two or three months.

The Americans have also realized that it is too expensive to use the space shuttle for launching satellites. Moreover, the Americans have been increasingly reducing the space shuttle program and they would also like to shift to our system. The Freedom space station, due to commence operations in 1995, is also part of this new program. The Americans also want to use "disposable" rockets, rather than the space shuttle, to send the various parts of the aforementioned space station into space.

[Desi] The Soviets also have their own space shuttle, the Buran.

[Kerimov] The Buran was born in the wake of a political decision. At the time, the Soviet political leadership regarded the U.S. space shuttle as a potential weapon and threat. Therefore, our leadership gave the order to build something similar. Essentially, our Buran does the same things as the Space Shuttle and, naturally, it is as expensive as the Space Shuttle. However, our space shuttle is guided by an automatic device, and the Buran's rocket—the Energia—can also be used separately, while the Saturn used by the Space Shuttle can only be used with the space shuttle.

[Desi] Still, what do you plan to do with the Buran?

[Kerimov] We would like to send it into space around the end of 1992 in a modified version, with a crew on board. However, we had to slow the program recently because of a lack of funds.

[Desi] I presume this lack of funds is connected with the general problems facing the Soviet economy.

[Kerimov] The Soviet economic restructuring also affects us. Previously, we used to receive as much as we wanted from the central budget. However, today we only receive funds for basic research, and the rest we must earn ourselves. In other words, we are commercializing our services: For example, we are launching sputniks into space for commission. Our Buran program is secondary, and the Mir program continues to receive all the necessary support.

[Desi] By how much was your budget cut?

[Kerimov] We are getting now ten times less than we used to get before restructuring began. Manpower is the most expensive item, and we spend most of our budget on keeping the people.

[Desi] Quite strong Soviet-U.S. space research cooperation emerged in the seventies. What is left of this cooperation?

[Kerimov] This was a love affair that started nicely and came to a sudden end. Probably both sides are to blame for this. At present, we do not have any specific agreement, although former president Ronald Reagan also talked about a joint Soviet-U.S. Mars program. However, President Bush said last year that Americans would be the first to reach Mars.

[Desi] A certain regression could be noticed recently in general Hungarian-Soviet relations. To what extent can this be felt in space research, especially in view of the fact that Hungary used to take an active part in the Intercosmos program?

[Kerimov] One of the goals of my visit was to restore the good old relations on new foundations. Hungary can continue to participate in the Intercosmos program and we are ready to accept Hungarian cosmonauts too, if financial conditions are agreed on the basis of mutual interest.

[Desi] What results can we expect in space research in coming years?

[Kerimov] We can hardly count on a sudden development similar to the one prevailing in the sixties and seventies. In the future, Soviet space research will increasingly serve the interests of the Soviet economy and of solving our ecological problems. Besides, I am for international cooperation: Every "space nation" should contribute to the common cause with its best knowledge. Together, we could make a big leap more easily.

Problems With Public Services as Baykonur, Military's Role

917Q0095A Moscow KRASNAYA ZVEZDA in Russian 1 May 91 p 4

[Article by KRASNAYA ZVEZDA correspondent Colonel A. Ladin under the rubric "A View of the Problem" (Alma-Ata—Baykonur): "The Space Launch Facility From the Workers' Entrance"]

[Text] When Lieutenant General A. Kryzhko, chief of the Baykonur Space Launch Facility, invited me to spend a workday beside him, I could not even assume that I would see the main spaceport not from the main entrance.

From the doors of the headquarters we set off for the central...boiler house of the city of Leninsk, a city where people, who in one way or another are involved in space affairs, live. For the first time I had occasion to see what is "off screen."

The city heat and electric power plant, which, incidentally, officers, warrant officers, and ordinary soldiers of the space launch facility operate fully, made a painful impression on me. It is putting it mildly to say that the working conditions in this steaming, whistling entanglement of pipes, cables, and steam and electric units, which is smoked up by sulfurous waste, do not meet any standards. You are amazed at how in general specialists here endure the watches at posts. The heat and electric power plant exerts itself with its obsolete, not properly cared for equipment with all its might. But the city does not have enough heat (particularly in winter). A new boiler is being put into operation. However, it, too, will not solve all the problems....

How could one not have pondered there, in the smoky shops, why the seemingly wealthy space launch facility is so inconsiderate toward the heating facilities of the city, in which its people live? Lieutenant Colonel A. Tsvetkov, chief of a group of the inspectorate for the supervision of capital construction, believes, for example, that much is a result of the lack of development of military construction personnel under Col. A. Katyukhin. Take if only the same problem with the placement of the boiler into operation. On the other hand, as one of the deputy chiefs of the space launch facility explained to me, the attitude toward the needs of the space launch facility and its objects, including those under construction, leaves much, to put it mildy, to be desired. Deliveries of materials are being disrupted. Fire brick, which should have been delivered long ago for repair work, was received half a year late. And that is good. For the shipment of necessary materials other partners openly demand recompense. Thus, one of the enterprises asked for Armenian short sheepskin coats. Another one needs metal and construction materials. But where is one to get all this?

The city dairy plant, for example, as its director, M. Zhausambayev, told me, for several weeks starting at the end of December was without dry milk. And now there is not enough of it to reliably supply the city with milk.

Lt. Col. Strusovskiy, chief of the section of support of the operation of the service of the chief engineer of the space launch facility, familiarized me with documents, from which it becomes clear: Contrary to the order of the USSR Council of Ministers of 15 September 1988 individual enterprises are refusing to conclude contracts with the space launch facility on a priority basis. The superior supply unit notified the service of the chief engineering that "fund notices for the conclusion of contracts will not be sent," "contracts should be concluded independently with the manufacturing plants." Is this bad or good? Today, as I understood, nothing good is evident from the fact that the space launch facility without consideration of its particular importance for the country is being driven into the general system of consumers.

By what is it possible to explain such negligence of other ministries and departments toward the space launch facility? On the one hand, apparently, by the fact that the wave of chaos and the severing of economic ties, which is characteristic today of the economy of the country as a whole, have also reached here. On the other hand, all this is a result of the underestimation of the role and importance of space research and the seal of secrecy, which for a long time has been lying on them. For sometimes it is also possible to hear the following opinion: "Should we not reduce the spending on everything that we are letting loose who knows where?" Moreover, not only, say, in line, but also from the rostrum of our primary parliament.

No one is also concealing the fact that large amounts of assets are being allocated for space purposes. But Baykonur is not a "black hole," into which enormous state investments simply vanish. What is being done here cannot be cheap. But the primary thing lies in something else: Space programs for a long time now have been yielding the country such a profit, which, most likely, covers all the previous expenditures.

Kazakhstan in the immediate future is "covering" the entire territory of the republic to the most remote aul with a network of its own, republic, television. A satellite, without which the named project would look like a flight of fancy, will help to implement this project. To say nothing of its cost. The satellite will help give the repulic modern branched communications of various types.

Here I found out about the space systems that serve both the national economy and defense. For example, sentry satellites follow vigilantly launches of missiles and at the necessary moment warn of the danger. Or there is the Tsikada space system, to which navigation satellites like the Kosmos-1000 belong. Tsikada provides seagoing vessels with the data necessary for operation. For example, by means of it the captain is capable of determining the coordinates of his vessel with an accuracy of 80-100 m.

Someone, perhaps, will say: But what is the benefit from this for, say, Uzbekistan, Kyrgyzstan, Kazakhstan, and other republics, which do not have large seaports and their own commercial and fishing fleets? Our fleet is the union fleet, while all our republics use it. The importance for them of lines of transportation, including sea lines of communications, is especially increasing now, when each republic, in making use of the possibilities of the proclaimed sovereignty, is entering into contacts with

foreign partners in various regions of the world. Union space hardware is working in the interests of all the sovereign subjects of the renewed federation. For alone, you will agree, no republic will be able to ensure the fulfillment of space programs.

I was lucky enough to watch the launch of the Progress space cargo ship. I found out then that ten, hundreds of servicemen—from an ordinary soldier to a major general—work in underground structures in the immediate vicinity of the launch complex, which supports the launch of the booster rocket. The courage and boldness of these people were staggering. But they do not pay any enormous amounts of money, as some people think, for such work at the space launch facility. It would be necessary to pay, I understand with my heart, but an officer of the launch crew cannot compare with respect to the wage even with the average cooperative member.... But someone somewhere should finally say: The rocket launcher crewmen of Baykonur are the most valuable workers. And draw the conclusions.

I listened to Kazakh SSR President N. Nazarbayev, when after an inspection of the space launch facility he addressed journalists. The president promised to fight for the most extensive glasnost of everything that the space launch facility has and expressed the wish that the leaders of all the republics would be here at Baykonur and that a tourist route for all Soviet citizens would be laid here. That would be splendid! Then they would also see: The space launch facility "eats bread" not for nothing.

But for the present unfinished jobs, incompletely maintained equipment and hardware, and the space program, which has been underfulfilled as a whole—this is the misfortune that has already fallen upon the space launch facility and threatens to turn into considerable losses. Perhaps, also into a lag in space research. What is the solution? I will speak for myself. However difficult it is for everyone, it is necessary to allocate for space research as much as the interests of the country and its security require. We should not allow the precious gain of several generations of scientists and production workers, through whose labor our country acquired the authority of a leading space power, to be lost in vain.

From the workers' entrance to the space launch facility I saw not only the boiler house. We drove to the bakery, and it is also serviced by soldiers' hands, then to the dairy plant, the meat combine, and the military sovkhoz, which provides the space launch facility with several types of products. Only what concerns the launch of spacecraft is, I believed, under the responsibility of the chief of the space launch facility. He is responsible, it turned out, for the continuous operation of the sewer system in the city of Leninsk, for the lighting of city streets and the removal of snow from them, for heat and the supply of city dwellers with everything necessary.

Of course, the management of the space launch facility could devote more attention to its purely space affairs, the Leninsk City Soviet of People's Deputies and its exxecutive committee should work, as it seemed to me, more actively, with a greater desire to overcome the accumulated economic problems.

It has now been decided to establish a special commission made up of representatives of the USSR Ministry of Defense, general machine building, and the government of the Kazakh SSR for the more complete study and the deciding of the needs and the solution of the problems that have accumulated at our main spaceport. How I wish that this would help to protect it against the destructive chaos of economic squabbling and rash parochial attacks, which are impeding the progress of our space science.

TASS Criticizes U.S. Shuttle's 'Star Wars' Mission [TASS 30 Apr 91]

LD3004102491 Moscow TASS in English 1000 GMT 30 Apr 91

[By TASS military analyst Vladimir Chernyshov]

[Text] Moscow April 30 TASS—The United States' launching the Discovery spaceship is a prominent event in science and engineering. The NBC TV company said in its news program that the launching is another step forward in the attempt to show that the Star Wars systems are operable.

With deep respect for the bravery of American astronauts, we should like to pose the following question: Is their present mission so honourable? The step forward is, in real fact, a dash backward to the arms race which Washington and Moscow seemed seriously to try to end.

Moreover, deploying Star Wars systems and testing their elements will involve shifting weapons to near-earth space. Consequently, this will mean the creation of a lethal sphere around our mother earth.

The Star Wars program is a Cold War relic. This is especially clear now that the USSR and the United States have turned to cooperation. The two sides are completing a Soviet-American treaty on the reduction of strategic offensive weapons, and Moscow and Washington are seeking to jointly build collective security.

The SDI program was a long-standing barrier to reaching mutually acceptable decisions at the Soviet-American talks in Geneva.

Although a year ago the Soviet Union decided not to link the non-militarisation of space with the conclusion of the START treaty (which gave new impetus to the negotiations), the shadow of Star Wars continues to darken the dialogue, questioning one side's implementation of the ABM treaty.

Expressing various opinions about SDI, Soviet and American specialists agree that the deployment of such a system would upset the strategic balance between the USSR and the United States.

On the other hand, its military effectiveness is strongly doubted.

Nevertheless, the U.S. Administration does not want to take a reasonable step that would conform to the realities of our times: to shake off the old dogmas of "star warriors".

It is high time to send programs of the SDI type to the archives. Let us hope that realism will take the upper hand in Washington.

U.S. Shuttle Mission Described, Contrasted With Buran Program

PM0105122191 Moscow IZVESTIYA in Russian 30 Apr 91 Union Edition p 8

[Interview with Colonel A. Radionov, leading specialist in USSR Defense Ministry Space Units, by V. Litovkin under "Details for IZVESTIYA" rubric; place and date not given: "What Discovery Is Carrying"]

[Text] The American reusable spacecraft Discovery was launched from Cape Canaveral at 1433 Moscow time 28 April. In the United States the flight program statement was brief—"carrying out scientific research work."

What in fact is Discovery carrying in its payload bay? Colonel A. Radionov, a leading specialist in the USSR Defense Ministry Space Units, tells us.

"The purpose of the flight is to carry out complex experiments and research into establishing satellite reconnaissance of space and orbital means of high-accuracy ballistic missile interception in space," Alexandr Ivanovich [Radionov] says. "The American astronauts—there are seven of them, working in two shifts, day and night—have to launch a number of spacecraft into orbit, some of which will then be returned to earth. These will carry out tasks of a reconnaissance nature and test methods of identifying warheads."

[Litovkin] What research apparatus is installed on board Discovery?

[Radionov] There are five systems. Their total payload is four and a half tonnes. The principal system is the "Cirris" [Cryogenic Infrared Radiance Instrumentation] infrared telescope, a kind of space night vision instrument. It has been developed specially for shuttle-type spacecraft and was first taken into space in 1982, where it was designed to record high-definition spectral characteristics of the earth's limb and the flame plumes of ballistic missiles in the upper layers of the atmosphere. That is to say a telescope capable of revealing warhead-carrying reentry vehicles against the luminous background of the planet, and consequently of helping to destroy them.

On board there is also a radiometer, a space radar, and an ultraviolet telescope which operates in conjunction with the radiometer and "Cirris."

One interesting detail. The same instrument system is also located on the deployable unit. With the aid of the remote manipulator the unit will be injected into open space, and when the craft has made the appropriate maneuvers the unit will be located 10 km behind and 1,525 meters below it. This enables both the general configuration and the spectral characteristics of the plumes of the ship's operating engines to be observed, which is fundamentally important in setting up high-accuracy methods of hitting ballistic missiles.

Three small satellites will be launched into space in addition to this unit. Their payload is in the region of 85 kg, and their distance from the craft will be around 150 km. On a command from earth they are to eject various types of missile fuel components into space. In this way the possibility of camouflaging missile warheads and finding them in a gaseous cloud will be tested.

[Litovkin] So you mean they are testing components of the Strategic Defense Initiative?

[Radionov] It's not me saying this; it's what the Americans themselves are claiming.

[Litovkin] What other instruments will be launched into space?

[Radionov] There are two other satellites aboard Discovery. One of these is a small Lightsat weighing 60-70 kg. The U.S. military leadership plans to use spacecraft of this type as communications, reconnaissance, navigation and meteorological data provision tools for commanders in the tactical chain—tank, platoon, and company commanders...

The second spacecraft, weighing 1,926 kg, comprises five containers carrying a secret payload designed to test the advanced components, assemblies, and hardware of future military items in space.

[Litovkin] Is our Buran also capable of carrying out these tasks?

[Radionov] It's hard to answer this question. Nobody has ever required it to perform tasks of this sort. Its test flight planned for the end of 1991 or the start of 1992 envisages docking with the Mir orbital station, transmitting the results of on-board experiments from orbit, and testing the cosmonauts' rescue procedures.

As you can see, the tasks are exclusively economic and scientific in character. And they have no relation whatsoever with the military establishment.

IZVESTIYA on Topaz Reactor Imbroglio

91UF0724A Moscow IZVESTIYA in Russian 7 May 91 Union Edition p 2

[Article by S. Leskov: "The Adventures of a Soviet Reactor in America"]

[Text] **A few days ago IZVESTIYA (No. 96, 1991) reported that the Soviet Topaz-2 nuclear reactor model, which had been exhibited at the international fair in Albuquerque, had been prohibited from being taken out of the United States. The situation is, by all counts, extraordinary. We already reported on the U.S. side's reaction. What is our specialists' opinion of the events?**

"During the last few months, there were political games played around Topaz-2—by both sides," N. Ponomarev-Sedoy, first deputy director of the Kurchatov Nuclear Power Institute, expressed his view on the incident. "The victims of such games are both the business and specific people. As before—when a Soviet reactor caused a burst of attention by its alleged potential for use in the SDI program—I do not see any reasons to sound alarms."

Could it be that while Topaz-2 is forcibly detained on the other side of the ocean the Americans will pry out some design secrets? N. Ponomarev-Sedoy assured us that the reactor is in a container sealed by our specialists. In general, N. Ponomarev-Sedoy believes there is no need to rush Topaz-2's return home. The reactor is currently being exhibited at various international fairs. At the same time, there are no resources or appropriate buildings at home to store such a unit properly. Nevertheless, if the issue of the unit's return to the USSR is not resolved in a positive manner, we are not going to leave this "gift" to the United States—the reactor will simply be destroyed.

Still, it is necessary to draw some lessons from the events. One may throw a stone at the American bureaucracy that slapped a veto on the export of nuclear devices, even on their way home. American nuclear scientists are now saying with a guilty feeling that their bureaucracy turned out to be no better than our Soviet one. But it will not do us any good to discuss the merits of someone else's bureaucracy. If we are serious about cooperation with the United States, it would not hurt to learn some of the laws of that country, especially 40-year-old ones. However, it did not occur to anybody to figure out foreign laws. Our delegation in Albuquerque learned about potential problems with the reactor's return only in January, after the unit had already been delivered to the United States.

Alarmed dispatches from across the ocean about the reactor's "arrest" did not turn out to be news for our specialists. What did they hope for? We received a guarantee in January—verbally—that the lawyers will find a loophole in American legislation that will allow this paradoxical situation to be resolved. But time goes on, and a loophole has not been found. Just recently, representatives of the Nuclear Regulatory Commission visited Moscow. In their opinion, there is only one chance left: to bring the question up at the highest political level, and to ask the administration for a one-time permit to export the unit back to the USSR.

And, perhaps, the most important point: Will not all these troubles influence the Americans' intentions to buy the Soviet reactor? This is not something we are indifferent to—the approximate value of the contract is $10 million, which would come in very handy in the situation where budget financing for work in this prospective area has been cut. Currently, a version of the contract signed by the American side has been passed to Moscow. By the way, the contract stipulates the return of the industrial prototype to the USSR. But if such legal possibilities were there from the beginning, it is hard to understand why they were not used to export an exhibition model?

One way or the other, after the necessary clarifications were made, even the strictest Soviet authorities approved the contract. The delay is in the Ministry of Defense. Many years ago this department cut the financing for Topaz and lost all interest in it. Now they propose—as is typical here—to create a commission: Such a process can go on for years. It should be emphasized that authoritative specialists in both the United States and the USSR believe in principle, based on its technical characteristics, that Topaz-2 cannot be used for the SDI program—if for no other reason, then because the unit's technology is on the level of 15 years ago. Besides, the contract for the purchase of the reactor stipulates firm guarantees on the part of the American side that the unit will not be used for military purposes. Another point is that, according to the contract, the reactor's "know-how" is not to be violated—the unit cannot be dismantled.

Still, it is hard to say whose bureaucracy is worse. Research in space nuclear reactors, deprived of domestic financing and financial support from abroad, is facing a sad fate. Scientists in the Nuclear Power Institute involved in the Topaz project are already experiencing financial difficulties, such as meeting the payroll. And this is in one of the rare areas where we hold an advantage—space nuclear devices.

U.S. Decision To Release Topaz Reactor Reported

PM1305104391 Moscow IZVESTIYA in Russian 11 May 91 Union Edition p 2

[S. Leskov report: "Soviet Reactor 'Released'"]

[Text] IZVESTIYA reported the "arrest" of the Soviet nuclear installation "Topaz-2," which was banned from being brought back from the United States after being displayed at an international exhibition in Albuquerque. Here is the latest report: The U.S. Nuclear Regulatory Commission has reviewed its decision and allowed the reactor, which is installed on space apparatuses, to return to the USSR.

It is hard to tell why the decision was revised. Either because U.S. specialists voiced concerted indignation at their bureaucrats' actions, or because of talks that the commission's representatives had during a recent visit to

Moscow, or maybe because of Academician N. Ponomarev-Stepnoy's direct appeal to U.S. President G. Bush.

"Topaz-2" can come home. But it is quite possible that it will extend its stay across the ocean—now of its own free will. While the White House is preparing the official documentation, the Americans have suggested that Soviet scientists exhibit the reactor at the world's largest museum, the Smithsonian in Washington.

Soviet-European Space Conference Begins

LD1305134191 Moscow TASS in English 1314 GMT 13 May 91

[By TASS correspondent Vladimir Khrustov]

[Text] Moscow May 13 TASS—Problems and Prospects for the development [of the] aerospace complex and related industries, joint space projects of European countries and training of specialists for the aerospace industry are the main topics discussed by participants in the first conference of heads of leading Soviet and European aerospace firms.

The Soviet-European industrial space dialogue opened today at the center of international trade and scientific and technological ties with foreign countries. It is sponsored by the European Space Agency and the international research and training center Cosmos.

"Achievements of Soviet and world cosmonautics show that the economy of many countries gains from uses of space", Academician Ryzhov, chairman of the Soviet parliamentary committee for science and technologies, president of the international scientific and training center Cosmos and rector of the Moscow Aviation Institute, said at the opening of the conference.

"Apparently, the gain could be larger if all countries which are actively engaged in space exploration, including European countries, developed wider international cooperation and specialization. This would make it possible to avoid unnecessary duplication and save large funds. The Soviet Union, for instance, could offer its partners high-capacity boosters to put heavy earth satellites and other spacecraft in orbit".

G. Van Reeth, managing director of the European Space agency, shared the views of Academician Ryzhov. He dwelt on European space projects and programs which can be implemented in near future.

Many well-known Soviet space firms display their projects showing achievements and prospects of the Soviet space science and its contribution to the national economy and the development of international cooperation in space exploration. Scientists and specialists of scientific production amalgamations "Energiya", "Molniya", "Vympel", "Kompozit", design office "Salyut" and others participate in the conference.

Text of Gorbachev Message to Space Agencies Moscow Forum

PM1705142391 Moscow PRAVDA in Russian 17 May 91 Second Edition p 1

["USSR President's Greeting to Participants in Space Agencies Moscow Forum"—PRAVDA headline]

[Text] I welcome to Moscow the participants in the space agencies forum. I hope that your meeting to prepare for International Space Year, which is to be held under UN auspices, will help unite a broad range of specialists and public figures in the interests of the comprehensive study of the planet Earth.

The cooperation between many states in studying the earth's resources, conducting space-based environmental surveys, and using satellite communications for extensive humanitarian and technical purposes constitutes a graphic example of the effective concentration of international efforts. I am sure that the future of space exploration lies not in star wars but in fruitful work to meet the urgent needs of the peoples of all countries—large and small, West and East, North and South.

Having recently celebrated in conjunction with other countries the 30th anniversary of man's first space flight, the Soviet Union is willing to continue to participate actively in international space programs for the benefit of man and the whole world community.

I wish the participants in the Moscow forum creative success.

[Signed] M. Gorbachev

Three-Day Soviet-West European Space Conference Ends

LD1505203391 Moscow TASS in English 1616 GMT 15 May 91

[By TASS correspondent Rena Kuznetsova]

[Text] Moscow May 15 TASS—"The dialogue between Soviet and West European specialists engaged in peace space explorations, was a success," Director-General of the Elektropribor Scientific and Production Amalgamation Yakov Ayzenberg told TASS here today.

The three-day conference of the heads of leading Soviet and European aerospace firms ended here today. This is the first meeting of this type.

The choice of the place was not accidental: the Soviet Union is among leading space states having the impressive experience of space exploration, Ayzenberg noted. The Soviet space program is being implemented by top-notch specialists.

The conference was attended by 50 specialists from European countries. The forum's sponsors include the

European Space Agency and the Cosmos International Training and Research Center.

Accord on Cooperation With European Firms

PM2205132591 Moscow KRASNAYA ZVEZDA in Russian 16 May 91 Second Edition p 1

[TASS correspondent L. Dunayeva report: "Space Dialogue"]

[Text] Moscow, 15 May—A meeting involving leaders of foremost Soviet and European aerospace firms closed today with an accord on cooperation in and cadre training for the aerospace industry and on conversion studies. Scientists and business people from Belgian, British, German, and other Western firms took part in the work of the first meeting, entitled "Soviet-European Industrial Space Dialogue."

They had an extensive exchange of opinions on the use of satellites in establishing meteorology and communications systems and obtaining ultra-pure substances in space and on ways of shipping them back to earth. The problem of energy procurement and transfer in space using laser beams aroused great interest. It was noted that the incipient conversion in the USSR will make it possible to utilize defense sectors' scientific potential in metallurgy, machine building, and electronics.

The development of the space industry urgently requires special cadres. Their training is being undertaken by the "Kosmos" academic scientific center set up at the Moscow Aviation Institute. O. Alifanov, the center's general director, said during a conversation with a TASS correspondent that both Soviet and foreign students will receive instruction at the aerospace school.

Japanese Firm's Bankruptcy Means Financial Loss For NPO Energiya

LD0505195791 Moscow TASS International Service in Russian 0918 GMT 5 May 91

[Text] Tokyo, 5 May (TASS)—It appears likely that the Soviet launch vehicle "Soyuz", launched last August, will remain the only "space vehicle" boasting the logo of the Japanese "Pax Corporation Limited" [as received] on its board. As the MAINICHI newspaper reports today, an unexpected bankruptcy of the well-known Tokyo- based corporation leaves no hope that a contract it earlier signed with the "Energiya" scientific-production association, specializing in the design and production of space transportation crafts, will be ever fulfilled.

According to the document, "Energiya" pledged, among other things, to place advertisements on their spacecrafts' frames and to launch the company's satellite into orbit, as well as retransmit Japanese television programs via Soviet satellites. Fulfilling the contract with "Pax Corporation Limited" promised, for "Energiya", considerable financial gains which would by no means be superfluous for the scientific-production association which, like many enterprises in the USSR has entered a complex stage of conversion. However, instead of receiving hard currency, Soviet spacecraft builders are faced with the need to count their losses. The Japanese corporation's bankruptcy left "Energiya" among its 200 creditors currently awaiting debt compensation from their former partner in business. The Japanese failed to pay their bills for over $4.5 million of work already completed by "Energiya". This is the first time, MAINICHI writes, that the Soviet side has suffered a considerable loss from cooperation with Japanese companies.

Press 'Denied' Coverage Rights for 'Juno' Space Launch

PM2005134391 Moscow PRAVDA in Russian 20 May 91 Second Edition pp 1, 2

[A. Tarasov report: "One Second Fast"]

[Excerpt] This evening the hatch of the Mir orbital station is to open for the most famous woman in Britain.

No, I have not made a slip. This week, at least, Helen Sharman has rightly become a real celebrity in the British Isles.

How can it be otherwise, seeing that each people sends its first cosmonaut beyond the confines of the earth only once in its history? This is for all the future centuries and millennia. I am pleased for the brave and assiduous girl and for proud Britain, which has at last become a space power and caught up with Syria and Afghanistan in this sphere.

And all thanks to the charity of our mighty space sector and its chief firm "Energiya." Why charity?

Judge for yourselves. The money for the "British" flight has, in practice, been shelled out of our own State Bank's pocket. There is not a single British scientific instrument in the program.

Not that I am against this. Do not think that. Just as I was not against the joint "Intercosmos" festivals during the preceding decade of fanfares. In general, I place friendship above profit and pettiness. Let us take everyone without exception for a fast, free ride in our space "troika." Country after country, in turn, just as we began, without haggling.

But then there is no need to strike the pose of those inveterate businessmen and miserly knights who pawn even their own Soviet press. But it is necessary—for the first time in history it was denied an organized flight to the launch. Our esteemed foreign colleagues received all the coverage rights, while our fraternity blinked after their arcraft... If Baykonur were a civilized zone, we would be a little more independent. But it does not feature either on Aeroflot's map or in the schedule, and

here you are tied to all sorts of lists—on board, in the bus, in the hotel. If you have not got on, you are no use to anyone.

It is not a matter of petty shop grievances. It is a matter of an inveterate principle: Fend off your own, but bend over backward for foreigners. And total indifference to your own public opinion. We will see where this can lead. [passage omitted]

Financing of British-Soviet Flight Questioned

917Q0103A Moscow KRASNAYA ZVEZDA in Russian 21 May 91 First Edition p 3

[Article by Colonel M. Rebrov, KRASNAYA ZVEZDA science columnist: "Space Project 'Juno,' or the Riddle of One Commercial Transaction"]

[Text] To start with, one fact is indisputable and recognized by everyone: The Soviet Union has the most active and substantial space program in the world. If we take just the statistics of the last 20 years we see that, on the average, we launched a spacecraft every four days. The Soviet "rocket flotilla" includes several varieties of launch vehicles that are capable of putting into space cargo weighing up to 100 tons. The guarantee of success in every launch is 92-98 percent. Hence the assertion: The shortest road to space goes through the USSR.

Many of our research programs are unique. The scientists of many countries dream of using the scientific base that the Mir orbital complex represents. Interest in our projects and our experience in the field of space technology, space production, power engineering, natural history, cartography, and other fields is great. We are ready for broad cooperation and to provide services to partners, of course, on a commercial basis.

The mutual benefit of joint actions in outer space should not be underestimated. Partnership relations with the scientific centers of France, the United States, Austria, Bulgaria, Germany, India, and other countries, the placement of foreign instruments on our satellites and automatic interplanetary stations, and the exchange of scientific information... All of this already exists. The prospects are far more alluring and broader: On one condition: If we are guided in scientific-economic policy not by ideological dogmas and illusions but by common sense.

Thus, the next space flight by commercial agreement has started its countdown of workdays. On 20 May at 1725 hours a representative of Great Britain, together with experienced colleagues from the USSR, should arrive at the Soviet orbital station Mir, and, judging by television reporting, he is very pleased. But we still do not know what commercial gain our country will get from this. Moreover, when you become familiar with this aspect of project "Juno," the impression is created that we are paying ourselves. Nonsense!

Nonetheless, I came to this conclusion after conducting a brief journalistic investigation. In order to clarify the situation I made a phone call to Glavkosmos [Main Administration for the Development and Use of Space Technology for the National Economy and Science], to the scientific production association Energiya, to Litsenzintorg [Foreign Trade Licensing].... However, my roaming about the commercial labyrinth did not lead to anything. I succeeded in establishing only a certain chronology of events and the names of some "influential persons" who showed an interest in the "Juno" project. Thus, Heinz Wolff, a professor at Brunel University in London, was actively engaged in the scientific program and prepared a series of experiments; Christopher Hays, a marketing expert, oversaw the project along the "bank credit" line; Mark Ragget, an insurance broker at the Dzhordayn company [name as transliterated], held all of the administrative threads in his own hands, and, according to a statement in the newspaper INDEPENDENT ON SUNDAY, he maintained contacts with "British industry," which was ready to be a sponsor of the project.

In 1987, Ragget made a business trip to Moscow, but after returning he convinced the president of the Dzhordayn company to become the chief sponsor of the Soviet-British space flight. The English press reacted enthusiastically to this event, but soon the cheerful reporting subsided, and later even fell silent. Without explaining the motives for its actions, Dzhordayn quite unexpectedly quit the game.

However, the resourceful broker quickly found a substitute, after getting the Moscow People's Bank interested in the project (I am still unable to explain what this organization is with a name so close to the heart). In 1989 M. Ragget and the bank established a joint company, giving it the imposing name Antequera, and declared that they are ready to invest 5 million pounds sterling in the space program. Moreover, they planned to take this sum from the safes of the Moscow People's Bank.

Events unfolded further this way. In June 1989 relations between the broker and the bank, or the other way round, suddenly got sharply worse, and, as TASS' London correspondent reported, the contract between the two high parties was annulled. Why so? Although the very fact of the collapse of the commercial transaction became apparent, much in this story is unclear to this day.

But here is what is curious. The insurance broker received "compensation in the amount of 30,000 pounds sterling." For what? After all, he did not invest anything, not a penny. It turns out that this large sum was paid in exchange for Ragget's firm and confidential promise "not to provide information on the project to the mass media." The bank itself categorically refused to comment on its decision.

Meanwhile, after the "silent divorce," the bank activated its efforts in search of a sponsor, because 16 million pounds sterling had to be gathered so that a representative of the United Kingdom could fly to outer space. But here disappointment was awaiting the Moscow People's Bank. The bosses of that same "British industry," to which the INDEPENDENT ON SUNDAY referred, did not display any particular interest in the "Juno" project, giving as the reason the fact that "there is nothing that strikes the imagination in its program." An even harsher judgment was heard: "The value of the project from a scientific standpoint is the same as that of a 'Miss Universe' beauty contest." We will leave this statement to the conscience of its author (in the English press he was called "a local consultant on space technology questions").

But at the same time in foggy Albion, a selection was held for candidates for the flight, two contestants entered into training (November 1989), and business negotiations were held between Moscow and London, but in August of last year the foreign press reported that the "joint project burst like a soap bubble." The aforementioned Christopher Hays gave assurances that hope is alive, and that this was a hasty statement "of poorly informed journalists." Today, we know: The British astronaut was launched on a Soviet spacecraft and is working in orbit. But there is something we do not know: Who will pay for this expensive arrangement?

Very likely, Mark Ragget could somehow clarify this question. But on 10 May last year he took his own life—he committed suicide. The official version: because of a financial mess. However, the question itself remains: "Who?"

My mind goes back to December 1990. It was reported at that time: "A Japanese journalist took part in a joint flight according to a commercial agreement between the USSR Glavkosmos and the Japanese television corporation TBS, which paid Glavkosmos $12 million."

Afterward there was one more optimistic assurance: "Outer space is becoming commercial," and a refinement of this: "Another four are on the way (a reference to joint flights—M.R.). They will be of a commercial nature. Each such flight will bring our country approximately $12 million."

Tempting. After all, such a flight costs us 60 million rubles. But I personally doubt that it will be this way. Doubts arise not so much because of the enigmatic story about the "Juno" project but because of our approach to commerce. The country has excellent design collectives, and, it can be said without exaggeration, the intellectual cream of the nation is assembled in the space industry, and our engineering ideas can amaze and delight the world. If what we are doing is good and profitable to sell, we will benefit greatly. I dare say it is advisable to entrust this task to professional businessmen. But for some reason we are trying to combine it all in one person.

However, let us return to the questions: "Who? For whom? How much?" I think that they also disturb the reader. But.... This all remains a secret for now.

Film Series to Show Previously Classified Space Archives

LD1905093691 Moscow TASS in English 0909 GMT 19 May 91

[by TASS correspondent Oleg Serdobolskiy]

[Text] Leningrad May 19 TASS—British lady cosmonaut Helen Sharman, who is now circling the earth on board the Soyuz TM-12 spaceship, will be a character in a documentary entitled "The Strength of the Weaker Sex". The picture is dedicated to the world's all "space ladies", beginning from Valentina Tereshkova and other women cosmonauts who were also prepared for a space flight.

The documentary is part of the "Man in Space" new serial, two parts of which have already been shown in Leningrad.

The new production by the Neva film studio (the Lenfilm Association) abounds in unique materials that were classified only recently, including hitherto unknown-to-the-public episodes of space tests and lift-offs, unsuccessful booster launches, and space walks.

There is also footage about a would-have-been cosmonaut Georgiy Nelyubov, who together with Yuriy Gagarin and Gherman Titov was preparing for the first-ever space flight but was expelled from the cosmonauts' unit for a disciplinary misdemeanor. "Upon the advent of glasnost, we have managed to fling the door open to the secret archives of the Soviet Defence Ministry's Energiya Association and show space endeavors unknown to cinema audiences," Yevgeniy Mezentsev, producer of the serial, told TASS.

He wrote the script together with Yaroslav Golovanov who had studied the space theme for many years.

The serial in the genre of philosophical essay will be crowned with the picture "Rendezvous Over the Planet" for the 15th anniversary of the Soyuz-Apollo test project.

TV Report From NPO Mashinostroyeniya, Almaz Project Described

LD2505174191

[Editorial Report] Moscow Central Television Second Program Network in Russian at 1615 GMT on 23 May broadcasts a video report from the Mashinostroyeniye Research and Production Association in Reutovo, near Moscow. The report deals with the Almaz unmanned space complex which is being developed at the research association.

The program begins with an interview with Gerbert Aleksandrovich Yefremov, captioned as general designer

of the Mashinostroyeniye research and production association, seated in his office. Speaking about his organization, Yefremov says:

"This is a defense enterprise. Therefore, until recently we could not meet you as openly as now. And this is our debut in the 'Man, the Earth, and the Universe' program. As far as space equipment is concerned, the main field of our interest is heavy orbital automatic stations with comprehensive possibilities, which are capable of carrying a great weight of research and practical equipment necessary for solving tasks and obtaining information from space." Yefremov goes on to speak about the history of the association and the importance of the space information it obtains for agriculture, natural resources, and global environmental problems.

The interview with Yefremov is followed by a shot of a large room with a mock-up of the "Almaz" unmanned complex. Igor Yuryevich Postnikov, captioned as the chief leading designer, tells viewers about the wonders of the "Almaz" complex: "We are in the room of the trial complex of the Mashinostroyeniye research and production association. You are facing a mock-up of the "Almaz" spacecraft. A special feature of this spacecraft is that it has the first home produced high definition radar on board. This radar will permit observations of the earth's surface from a height of 300 km. And we can see from space objects as small as 20-30 meters." He goes on to say: "The Almaz is also equipped with a television system and a number of instruments for research, including for the Moscow State University Nuclear Physics Research Institute."

Vladimir Vasilyevich Viter, captioned as deputy general designer of the Mashinostroyeniye research and production association, then speaks about the launch of the Almaz into space, which took place on 31 March. The first films arrived on 24 April, he says. The video shows stills of the earth's surface in the Moscow area, in northern Italy, and west Germany, and their geological structures. Viter explains the agricultural importance of various areas. The Almaz can lift great weights and communications with it are good, he says in conclusion, adding that the station will be further equipped to carry out research into environmental problems.

Intercosmos Chairman Outlines Agenda for 1992 International Space Year

LD1805081491 Moscow TASS in English 2032 GMT 17 May 91

[By TASS correspondent Rena Kuznetsova]

[Text] Moscow May 17 TASS—The world scientific community plans to give special emphasis to global ecology in every event of the international year of space which will be marked in 1992, Intercosmos Council Chairman Vladimir Kotelnikov told a news conference here today. The news conference was devoted to the results of the fourth session of the congress of space agencies devoted to the international year of space.

The Soviet Union plans to launch in 1992 an ecological module to dock with the Mir orbital station. The module will carry equipment devised by researchers from different countries, Kotelnikov said.

The Soviet researcher told the news conference that a total of 13 major projects will be carried out to study such global phenomena as the polar stratospheric ozone and the monitoring of the polar ice shield.

He noted that during the international year of space, which coincides with the 500th anniversary of discovery of America and the 35th anniversary of the launch of the first artificial earth satellite, the space agency around the world will seek to demonstrate the possibilities for the use of global research, the results of which were obtained from space.

The news conference was addressed by the leaders of organisations and departments dealing with the holding of the international year of space in Japan, Germany and the National Aerospace Agency of the United States.